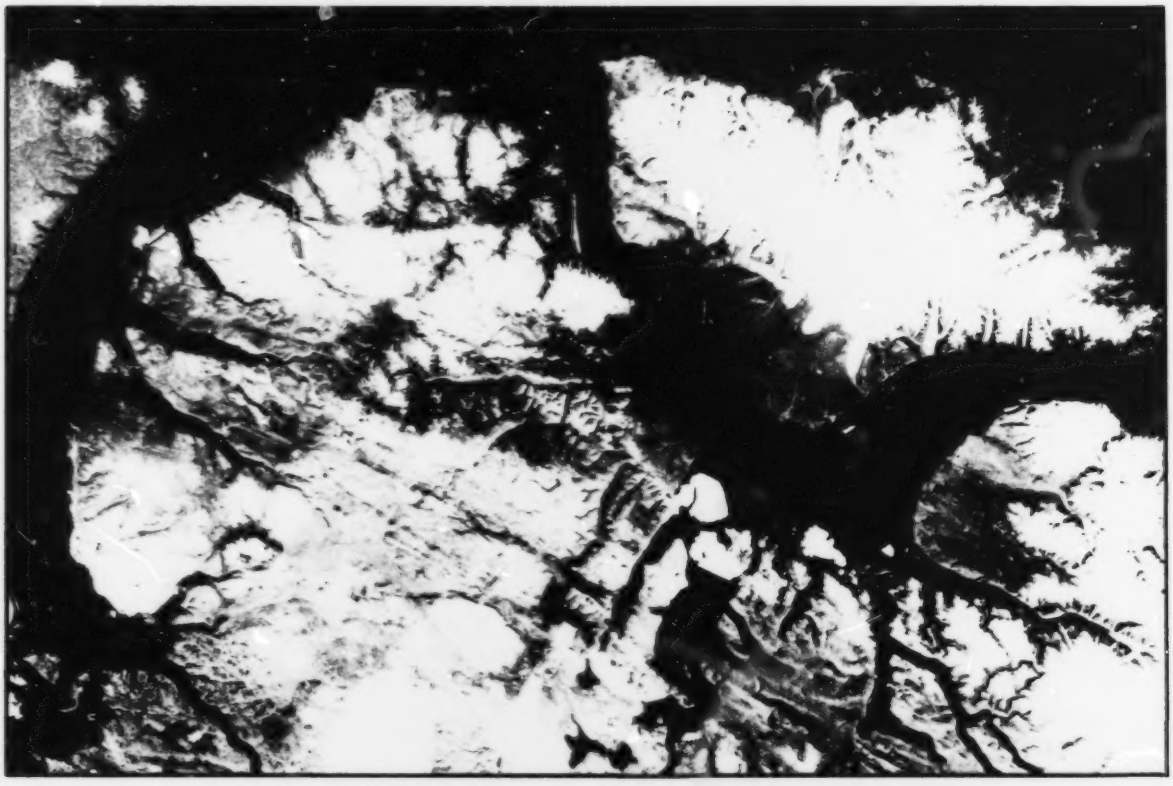
Geological Survey of Canada
Commission géologique du Canada

PAPER 87-17

GEOLOGY AND RESOURCE POTENTIAL OF A PROPOSED NATIONAL PARK, BYLOT ISLAND AND NORTHWEST BAFFIN ISLAND, NORTHWEST TERRITORIES

G.D. JACKSON
D.F. SANGSTER



Canada

1987

87-04982/

GEOLOGICAL SURVEY OF CANADA
PAPER 87-17

GEOLOGY AND RESOURCE POTENTIAL OF A PROPOSED NATIONAL PARK, BYLOT ISLAND AND NORTHWEST BAFFIN ISLAND, NORTHWEST TERRITORIES

G.D. JACKSON
D.F. SANGSTER

1987

© Minister of Supply and Services Canada 1987

Available in Canada through

authorized bookstore agents and other bookstores

or by mail from

Canadian Government Publishing Centre
Supply and Services Canada
Ottawa, Canada K1A 0S9

and from

Geological Survey of Canada offices:

601 Booth Street
Ottawa, Canada K1A 0E8

3303-33rd Street N.W.,
Calgary, Alberta T2L 2A7

A deposit copy of this publication is also available
for reference in public libraries across Canada

Cat. No. M44-87/17E Canada: $8.00
ISBN 0-660-12495-5 Other countries: $9.60

Price subject to change without notice

Cover

Mosaic of the study area constructed from satellite photographs

Critical Readers

G.M. Yeo (geology)
R.F.J. Scoates (resource potential)

Original manuscript received: 1986-04-15
Final version approved for publication: 1987-02-20

CONTENTS

1 Abstract/Résumé
2 Summary/Sommaire
3 Introduction
3 Selection of National Park areas
3 Present study
4 Regional Geology
4 Introduction
4 Archean-Aphebian Crystalline Basement Complex
4 Nebulitic gneiss (1)
4 Mary River Group (2)
5 Mixed rocks (3)
5 Meta-anorthosite, mangerite-jotunite (4)
5 Foliated to locally massive granitoid (including charnockitic) rocks (5)
5 Massive granite-granodiorite (6)
5 Structures
6 Metamorphism, age determinations
7 Neohelikian Borden Rift Basin
7 Introduction
7 Eqalulik Group (7-10)
7 Nauyat Formation (7)
9 Adams Sound Formation (8)
9 Arctic Bay Formation (9)
10 Fabricius Fiord Formation (10)
10 Uluksan Group (11-12)
11 Society Cliffs Formation (11)
11 Victor Bay Formation (12)
12 Nunatsiaq Group (13-17)
12 Athole Point Formation (13)
13 Strathcona Sound Formation (14-16)
14 Elwin Formation (17)
14 Evolution of Borden Basin
14 Faulting
14 Filling of the Basin
16 Metamorphism
16 Origin
16 Hadrynian Diabase Dykes
16 Early Paleozoic Basin and Shelf Sediments (18-20)
16 Cambrian and/or Early Ordovician
16 Admiralty Group (18)
17 Early and Early Middle Ordovician
17 Ship Point Formation (19)
17 Late Middle Ordovician to Middle Silurian
17 Brodeur Group (20)
17 Origin
18 Cretaceous-Eocene fault-related sediments
18 Eclipse Group (22)
18 Hassel Formation
18 Kanguk Formation
19 Eureka Sound Formation
19 Origin
19 Pleistocene – recent (23)
22 Mineral occurrences
22 Within study area
22 Lead-zinc
22 Copper
22 Iron
22 Gypsum
22 Coal
23 Bitumen
23 Adjacent to study area
23 Metallogenic summary
23 Metallogenic time-rock packages
23 Archean-Aphebian Crystalline Basement Complex
23 Borden Rift Basin

23 Paleozoic basin and shelf sedimentary rocks
24 Cretaceous-Eocene sedimentary rocks
24 Domains
24 Mineral and hydrocarbon potential
24 Methods of assessment
24 Minerals
24 Oil and natural gas
24 Coal
25 Assessment rating categories
25 Results
25 Petroleum and natural gas
26 Coal
26 Iron
26 Sediment-hosted stratiform lead-zinc
27 Mississippi Valley – type lead-zinc
27 Gypsum
27 Ultramafic-associated Nickel Sulphide
28 Sediment-hosted Stratabound Copper
28 Carving stone
28 Acknowledgments
29 References

Tables

8 I. Formations of Neohelikian Bylot Supergroup
17 II. Early Paleozoic Formations
18 III. Cretaceous-Tertiary Eclipse Group of Eclipse Trough
20 IV. Metallic and non-metallic mineral occurrences, Bylot Island and northwest Baffin Island
25 V. Rating criteria used in hydrocarbon and mineral assessment
26 VI. Undiscovered resources ratings, Bylot Island and northwest Baffin Island

Illustrations

in pocket Map 1-1987 Geology, mineral deposits and occurrences, northwest Baffin Island and Bylot Island, District of Franklin, Northwest Territories

4 1. Location of study area
6 2. Regional metamorphism in study area
9 3. Fault zones on Bylot and northwestern Baffin Islands
12 4. North Baffin Rift Zone
16 5. Hadrynian diabase dykes, Bylot and northwestern Baffin Islands
25 6. Diagram illustrating the relationships among potential-rating categories

GEOLOGY AND RESOURCE POTENTIAL OF A PROPOSED NATIONAL PARK, BYLOT ISLAND AND NORTHWEST BAFFIN ISLAND, NORTHWEST TERRITORIES

Abstract

An Archean-Aphebian felsic to intermediate gneiss complex, metamorphosed to amphibolite and granulite grade, underlies most of the area. Remnants of the late Archean Mary River Group in the complex contain iron formation and mafic to ultramafic rocks.

Six kilometres of Neohelikian strata, deposited in the Borden Rift Basin (aulacogen), nonconformably overlie the basement complex. Plateau basalts, low in the sequence, contain traces of copper. Gypsum, numerous lead-zinc deposits (including the Nanisivik mine), small hematite bodies, and traces of copper and bitumen occur chiefly in the middle platform carbonate sequence. Northwesterly- to northerly-trending diabase dykes are most abundant in the Neohelikian strata

One kilometre of early Paleozoic strata and 3 km of Cretaceous-Eocene strata overlie older rocks unconformably. Coal lenses occur in the lower Cretaceous-Eocene strata. Faulting accompanied Neohelikian, Paleozoic and Cretaceous-Eocene sedimentation.

Twenty-seven of the 51 mineral and hydrocarbon deposits found in the study area are lead-zinc. Ten are iron, five are coal, four are copper and three are gypsum.

Aphebian to recent block faulting probably involved some listric faults. The resultant horsts and grabens are the basis for dividing the area into five domains. Each domain is underlain chiefly by one of the four major rock units (Archean-Aphebian basement, Neohelikian, early Paleozoic, Cretaceous-Eocene) which, in effect, are metallogenic time-rock packages.

The likelihood of new mineral and hydrocarbon deposits in each domain was assessed. There is little chance for petroleum and natural gas accumulations, although several favourable structures occur offshore. The likelihood of additional coal in Domain 2 is moderately high. Domain 3 has a high to very high potential for more lead-zinc and gypsum occurrences. The potential for additional deposits of iron, nickel and sedimentary copper in any of the domains ranges from moderately high to very low.

Résumé

Un complexe gneissique felsique à intermédiaire de l'Archéen-Aphébien, métamorphisé jusqu'au faciès amphibolitique et granulitique, supporte presque toute la région. Des vestiges du groupe de Mary River de l'Archéen supérieur, qui se trouve dans ce complexe, contiennent une formation ferrifère et des roches mafiques à ultramafiques.

Six kilomètres de strates néohélikiennes déposées dans l'autracogène de Borden, recouvrent en discordance le complexe. Le plateau basaltique, qui se situe dans la partie basse de la séquence, contient des traces de cuivre. Du gypse, un bon nombre de gisements plombo-zincifères (y compris la mine Nanisivik) de petites masses d'hématite, des traces de cuivre et de bitume apparaissent principalement au centre de la plate-forme que constitue la séquence de roches carbonatées. Les dykes à diabase orientés du nord-ouest au nord sont plus abondants dans les strates néohélikiennes.

Un kilomètre de strates du Paléozoïque inférieur et trois kilomètres de strates crétacés-éocènes recouvrent en discordance les roches plus vieilles. Des lentilles charbonneuses sont présentes dans les strates qui datent du Crétacé inférieur à l'Éocène. Du faillage ont accompagné les sédimentations néohélikiennes, paléozoïques et crétacéo-éocènes.

D'une part, trente-sept des cinquante-et-un gisements minéraux et d'hydrocarbures trouvés dans la région levée sont des gisements plombo-zincifères; d'autre part, dix sont ferrifères, cinq charbonneux quatre cuprifères et trois gypsifères.

Du faillage aphébien jusqu'au blocs récents comprenaient probablement quelques failles listriques. La formation de môles et de fossés d'effondrement sont, en fait, la base de la division de la région en cinq domaines. Chacun deux est supporté principalement par une des quatre unités rocheuses (socle de l'Archéen-Aphébien, Néohélikien, Paléozoïque inférieur, Crétacé-Éocène); ils forment des ensembles métallogéniques chrono-lithologiques.

La vraisemblance des gisements d'hydrocarbures et de nouveaux minéraux dans chaque domaine fut évalué. Il existe une mince chance qu'il y est des accumulations de pétrole et de gaz naturel, même s'il s'y trouve des structures favorables au large. L'existence d'encore plus de charbons dans le domaine 2 est modérément élevé. Le domaine 3 possède un potentiel qui varie d'élevé à très élevé pour encore plus de venues plombo-zincifères et gypsifères. Le potentiel de trouver d'autres gisements ferrifères, nikélifères et cuprifères dans ces domaines est modérément élevé à très bas.

Summary

Since 1979 it has been government policy that, before a national park reserve can be established in the territories, an assessment of its non-renewable resource potential is required. As a result, an assessment of an area on North Baffin Island has been carried out by the Geological Survey of Canada under the guidance of a committee of senior representatives from the Department of Energy, Mines and Resources, the Department of Indian and Northern Affairs, and Environment Canada, Parks.

Environment Canada, Parks has identified a large "area of interest" for a national park, within which final boundaries will be delineated later, based on mineral potential and a range of other considerations. The mineral assessment has accounted for mineral potential within this entire "area of interest". It is important to emphasize here that the area of interest was evaluated for its potential to contain undiscovered mineral and hydrocarbon resources without consideration of the possible economic viability of any such predicted resources.

Environment Canada, Parks is also proposing a national marine park in waters offshore from the proposed national park. The mineral assessment of the area of interest for the national park provides some information that is useful in assessing the non-renewable resource potential of the offshore area. More extensive resource assessment, particularly for hydrocarbons, is required and will be the subject of a separate study.

This report includes a geological compilation of the area, a hydrocarbon and mineral distribution map, a summary of known hydrocarbon and mineral occurrences and an assessment of the potential occurrence of other deposits.

Most of the area is underlain by a variety of migmatites and orthogneisses. This complex was intruded by granitic to basic dykes and sills and a few small plutons prior to the last regional high-grade metamorphism. Belts of metamorphosed sedimentary and volcanic rocks grade into the migmatites and form the Mary River Group which is host to significant iron ore deposits.

As much as 6100 m of late Proterozoic strata overlie the gneiss complex and are exposed in spectacular towering cliffs in northern Baffin Island and on Bylot Island. These comprise volcanics, quartzarenites, shale with interbedded siltstone and dolostone, interbedded shales and coarse carbonate clastics, dark coloured limestones, a succession of complexly interfingering sedimentary lithologies, and quartz-rich sandstones.

The report describes the complex Proterozoic history of the area based on an interpretation of the various lithologies.

Swarms of northwest-trending tholeiitic diabase dykes intruded the gneiss complex and the Late Proterozoic succession. Two ages of intrusion 950 Ma and 750 Ma have been identified.

Cambrian and/or Early Ordovician clastics and Early Middle Ordovician to Late Middle Ordovician to Middle Silurian clastics, dolostones and limestone are widespread on Brodeur Peninsula and are common on Borden Peninsula.

Small outcrops of Cretaceous-Eocene sediments occur on Bylot Island and in the vicinity of Pond Inlet.

Sommaire

Depuis 1979 la ligne de conduite du gouvernement veut qu'il y ait, avant qu'un emplacement du futur parc national puisse être établi dans les territoires, une évaluation de ses possibilités en ressources non renouvelables. En conséquence une évaluation d'une région du nord de l'île Baffin a été effectuée par la Commission géologique du Canada sous la direction d'un comité de représentants supérieurs du ministère de l'Énergie, des Mines et des Ressources, du ministère des Affaires Indiennes et du Nord et d'Environnement Canada, Parcs.

Environnement Canada, Parcs a identifié une grande "région d'intérêt" pour l'implantation d'un parc national, à l'intérieur de laquelle des limites finales seront tracées plus tard, en fonction des possibilités minérales et d'une gamme d'autres considérations. L'évaluation des minéraux a rendu compte des possibilités en matières de minéraux à l'intérieur de toute cette "région d'intérêt". Il est important de souligner ici que la région d'intérêt a été évaluée en fonction de la possibilité qu'elle renferme des ressources minérales et des ressources en hydrocarbures non découvertes, sans égard à l'éventuelle viabilité économique de toute ressource prévue.

Environment Canada, Parcs propose également la création d'un parc national marin dans les eaux au large du parc national proposé. L'évaluation des minéraux de la région intéressante pour la création d'un parc national fournit des renseignements utiles pour l'évaluation des possibilités en ressources non renouvelables de la région au large. Une évaluation plus poussée des ressources, en particulier dans le cas des hydrocarbures, est nécessaire et fera l'objet d'une étude distincte.

Le présent rapport fournit une compilation géologique pour la région, une carte de répartition des hydrocarbures et des minéraux, un résumé des manifestations connues d'hydrocarbures et de minéraux et une évaluation des probabilités d'existence d'autres gisements.

Diverses magmatites et orthogneiss couvrent la plus grande partie de la région. Le complexe a été pénétré par des dykes et des sills granitiques à basiques ainsi que par quelques petits plutons avant la dernière phase de métamorphisme régional intense. Des zones de roches sédimentaires et volcaniques métamorphisées passent progressivement aux roches migmatitiques et forment le groupe de Mary River qui recèle d'importants gisements de minerai de fer.

Jusqu'à 6100 m de strates du Protérozoïque supérieur recouvrent le complexe gneissique et sont mises à nu dans les saisissantes et très hautes falaises du nord de l'île Baffin et de l'île Bylot. Elles se composent de roches volcaniques, de quartzites sédimentaires, d'argiles litées interstratifiées de microgrès et de dolomie, d'argiles litées aux couches alternativement tendres et résistantes, de dolomie, d'argiles litées interstratifiées de roches détritiques carbonatées à grain grossier, de calcaires foncés, une succession de lithologies sédimentaires imbriquées de manière complexe, et de grès riches en quartz.

Le rapport décrit l'histoire protérozoïque complexe de la région d'après une interprétation des diverses lithologies. Des groupes de dykes de diabase tholéiitique d'orientation nord-ouest ont pénétré le complexe gneissique et la succession du Protérozoïque supérieur. On a identifié deux époques d'intrusion, soit il y a 950 Ma et 750 Ma.

Les roches détritiques du Cambrien et de l'Ordovicien inférieur, ou des deux, ainsi que les roches détritiques, les dolomies et le calcaire du début à la fin de l'Ordovicien moyen et au Silurien moyen sont répandues dans la presqu'île Brodeur et commune dans la péninsule Borden.

Il existe de petits affleurements de sédiments du Crétacé et de l'Éocène sur l'île Bylot et aux environs de Pond Inlet.

There are four major metallogenic time-rock groupings. These are the gneiss complex, the Proterozoic succession, the early Paleozoic sedimentary rocks and the Cretaceous-Eocene sequence. The report examines these in relation to known structures and mineral deposits. Based on structural relationships the area is divided into five Domains each of which is assessed for its mineral and hydrocarbon potential using a variety of standard assessment techniques.

The area of interest has undergone extensive block faulting, chiefly northwesterly-trending, resulting in a series of alternating highs and lows across the area. These fault blocks, and their contained rock types, form the basis for outlining subdivisions referred to as domains.

The study has identified more than 50 mineral occurrences in the area of interest and predicts others. About half of those identified are lead-zinc. One-fifth are iron; coal, copper, and gypsum are each about one-tenth in abundance.

Nanisivik, a major lead-zinc mine, is located within Domain 3 on the south shore of Strathcona Sound. The rock units in Domain 3, which contain the Nanisivik Mine and which have a high to very high potential for more lead-zinc as well as gypsum, continue southeast for 300 km across Borden Peninsula to the southeastern corner of the area of interest.

Known coal-bearing rocks occur in Domain 2 on southwest Bylot Island and along the southwest shore of Eclipse Sound near the community of Pond Inlet. The likelihood of additional coal in Domain 2 is considered to be moderately high.

The presence of a large iron deposit south of the area of interest at Mary River, 88 km southeast of the south end of Milne Inlet, is of significance because the units that contain this deposit extend into the area of interest. The deposit is known to be one of the world's richest concentrations of iron. However, the potential for additional deposits of iron, nickel, and copper in any of the domains within the area of interest is considered to range from low to very low.

There is little chance of petroleum or natural gas accumulations within the proposed park area although several favourable structures are suspected offshore in Lancaster Sound.

Il y a quatre grands groupes métallogéniques de roches de différentes périodes: le complexe gneissique, la succession protérozoique, les roches sédimentaires du Paléozoique inférieur et la séquence Crétacé-Éocène. Le rapport examine ces grands groupes relativement aux structures connues et aux gisements minéraux. D'après les relations structurales la région est divisée en cinq domaines dont on évalue individuellement les possibilités pour les minéraux et les hydrocarbures au moyen d'une gamme de méthodes ordinaires d'évaluation.

Il y a eu dans la région d'intérêt la formation d'un grand nombre de blocs faillées, principalement d'orientation nord-ouest, qui résultent en une succession de zones alternativement élevées et basses. Ces blocs faillés et les types de roches qu'ils renferment, sont à la base de la délimitation des subdivisions appelées domaines.

L'étude a permis d'identifier plus de 50 manifestations minérales dans la région d'intérêt et on en prévoit d'autres. Parmi les manifestations identifiées environ 25 sont de plomb-zinc, une dizaine de fer et on en compte environ cinq dans chaque cas pour le charbon, le cuivre et le gypse.

La mine de Nanisivik, une importante mine de plomb-zinc, est située à l'intérieur du domaine 3 sur la rive méridionale de la baie Strathcona. Les unités lithostratigraphiques du domaine 3, où se trouve la mine de Nanisivik et qui présentent des possibilités variant d'élevées à très élevées quant à l'existence d'autres gisements de plomb-zinc ainsi que de gypse, se prolongent vers le sud-est sur 300 km dans la péninsule Borden jusqu'à l'angle sud-est de la région d'intérêt.

Il y a des manifestations connues de roches carbonifères dans le domaine 2, dans la partie sud-ouest de l'île Bylot ainsi que le long du rivage sud-ouest du détroit d'Éclipse près de la communauté de Pond Inlet. On considère modérément élevée la probabilité d'existence d'autre charbon dans le domaine 2.

La présence d'un grand gisement de fer au sud de la région d'intérêt à Mary River, à 88 km au sud-est de l'extrémité sud de la baie Milne, est d'une certaine importance parce que les unités qui renferment ce gisement se prolongent dans la région d'intérêt. On sait que ce gisement constitue l'une des plus riches concentrations de fer au monde. Toutefois les possibilités d'autres gisements de fer, de nickel et de cuivre dans tous les autres domaines de la région d'intérêt varient de faibles à très faibles.

Il est peu probable qu'il existe des accumulations de pétrole ou de gaz naturel à l'intérieur de la région proposée comme parc, mais on soupçonne l'existence de plusieurs structures favorables au large dans le détroit de Lancaster.

INTRODUCTION

Selection of National Park areas

Before a national park reserve can be established in the Northwest Territories, an assessment of its non-renewable resource potential is required. This is carried out under the guidance of the Special Subcommittee for Mineral and Fuel Resource Assessments which consists of representatives from Parks Canada, Department of Indian and Northern Affairs, and Department of Energy, Mines and Resources.

The initial assessment (Phase I) is a review of all available geoscience information. The assessment may end at this stage and a land withdrawal made with the possibility of further boundary adjustments to exclude local areas of high mineral potential.

If the subcommittee feels more information is required before a final decision is made, it may recommend proceeding to Phase II of the assessment process. Under Phase II, additional field work to obtain information specifically for resource assessment purposes would be carried out and could include surface geological studies, geochemical or geophysical programs, and limited diamond drilling. Any activities associated with such field work would be such that the natural values of the proposed park would not be impaired.

Present study

This report presents Phase I of a non-renewable resource assessment of a portion of northwest Baffin Island being considered for a national park. As such it includes a geological compilation of the area, a hydrocarbon and mineral distribution map, a summary of known hydrocarbon and mineral occurrences and deposits, mineral and hydrocarbon potential ratings of subareas within the study area, and descriptions of the methods and rationales used in deriving the assessment ratings.

Assessments of non-renewable resource potential are directed mainly toward evaluating the "potential-to-occur" of as yet undiscovered deposits. The process considers only the assessment of the geological favourability of the study area;

factors which could affect the economic viability of any deposits that might be found are not considered. Neither are known deposits in the study area examined as to their present or future potential to be exploited.

The study area of this report was selected by Parks Canada and includes Bylot Island and Borden Peninsula in northwest Baffin Island. The area delineated in Figure 1 outlines the general area within which definitive park boundaries would eventually be established and has been defined primarily on the basis of regional-scale information. Final park boundaries will consider site-specific information such as existing land use and mineral potential, as well as more detailed information on natural resources.

REGIONAL GEOLOGY

Introduction

The geology of Bylot Island and that part of Baffin Island north of 71°45'N latitude, east of Admiralty Inlet (ca 86°W longitude) and west of 76°W longitude (Fig. 1) contains six major geological units:

Archean-Aphebian crystalline complex
Neohelikian Borden Rift Basin
Hadrynian diabase dykes
early Paleozoic basin and shelf sediments
Cretaceous-Eocene fault-related sediments
Pleistocene-Recent unconsolidated sediments.

The region lies within the North Baffin Rift Zone and at least some of the sediments within three of the major Neohelikian to Eocene units are related to movements along chiefly northwest-trending faults. These have been active probably from late Aphebian to Recent time (Jackson et al., 1975). Only a brief description of the major units is presented below and the reader is referred to the references provided for additional information. In the following descriptions, numbers in brackets following the unit titles refer to numbers in the map legend (Map 1-1987, in pocket).

Archean-Aphebian Crystalline Basement Complex (1-6)

Most of the map area is underlain by a variable complex of high grade acidic to intermediate gneisses that are mostly migmatites, but also includes orthogneisses. These gneisses were cut by granitic to basic dykes and sills and a few small ultramafic, gabbroic, anorthositic and monzo-granitic plutons prior to the last regional high-grade metamorphism. Granitic intrusions of at least two ages are present. They include pegmatites, aplite dykes and plutons and dykes of granite-granodiorite. Recognizable metasedimentary-metavolcanic belts up to 65 km long grade into the migmatites and form the Mary River Group. Late-tectonic, late-metamorphic granitic dykes and small plutons intrude the other rocks of the complex (Blackadar, 1970; Jackson and Davidson, 1975; Jackson et al., 1975, 1978a, 1980, 1985; Lemon and Blackadar, 1963).

Nebulitic gneiss (1)

This unit occurs chiefly east of Paquet Bay. It is largely light grey to light pinkish grey, nebulitic and foliated to weakly layered migmatitic gneiss. A streaky appearance is common and nebulae and schlieren commonly differ only slightly from the host rock. Minor varieties include augen-, porphyroblastic-, flaser-, and rodded gneisses. The rocks, as a whole, are of granodiorite to monzo-granite composition. They are medium grained, inequigranular, and locally contain potash feldspar megacrysts. Minor amphibolite, hornblendite, and metasediments locally comprise zones up to a few hundred metres across. Pegmatites, aplite dykes and other granitic intrusions of at least two ages intrude the nebulitic gneiss. A dome-shaped body of largely granular oligoclase occurs with nebulitic gneiss 25 km east of Paquet Bay.

This map unit is composed of a variety of metamorphosed rocks that are probably mostly metasediments and metamorphosed acid to intermediate extrusive and intrusive rocks.

Mary River Group (2)

Rocks correlated tentatively with the late Archean, iron formation-bearing Mary River Group in the Icebound Lake map area to the south (Gross, 1966; Jackson, 1966, 1978; Jackson et al., 1978b), occupy large areas between Oliver Sound and Pond Inlet, and at the southeastern end of Bylot Island. The Mary River Group, a typical Archean greenstone sequence, is intruded by at least two generations of granitic rocks.

Light to dark grey and dark greenish grey, in part mottled or greasy-looking, metasediments and metavolcanics predominate. They are also very thinly to thickly layered, and locally massive. Layering, which may reflect primary compositional differences, is the only primary structure observed.

The most abundant rock type, biotite-quartz-feldspar gneiss, is probably chiefly metasedimentary, but may include some acid to intermediate metavolcanics. Varying proportions of hornblende, potash feldspar, plagioclase, garnet, and magnetite are common. Sillimanite- and hypersthene-bearing, and rusty weathering gneisses and feldspathic quartzite occur locally. Thinly banded oxide- and silicate-facies iron formation outcrops at several localities from south of Tay Sound westward to south of Milne Inlet, and locally may be about 50 m thick. Lean, magnetite-bearing, metagreywacke-type iron formation occurs in migmatite east of Stephens Island, Milne Inlet. Iron formation boulders are abundant locally in ground moraine on Ragged Island and pure hematite float occurs adjacent to the terminus of Sermilik Glacier near the south shore of Bylot Island.

Much of the Mary River Group is amphibolite derived chiefly from basic volcanics, but some coarse grained metagabbros are also present. Common accessory minerals are

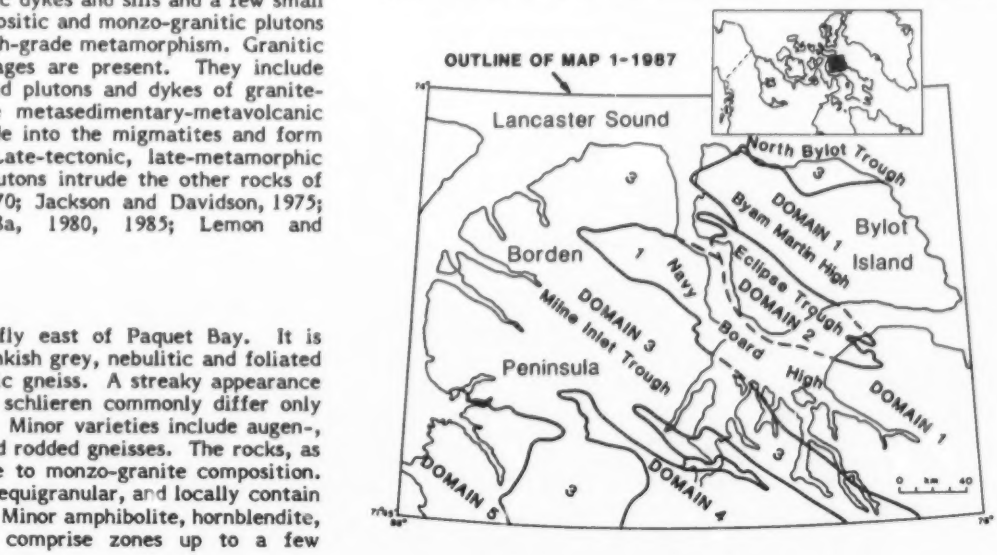


Figure 1. Location of study area.

garnet, chlorite, epidote, and magnetite. Clinopyroxene, hypersthene, anthophyllite and cummingtonite are abundant locally and eclogites and anorthositic layers occur here and there.

Small meta-ultramafic bodies and remnants are a common but minor component. They may include more than one age of intrusion, and seem to be most common in the Bruce Head area and in a region extending from Ragged Island east to Oliver Sound. Most bodies are hornblendite, pyroxenite, or biotite. A small blue-green body north of the mouth of Oliver Sound is composed chiefly of fine grained serpentine, and contains large, partially altered orthopyroxene crystals and olivine partially altered to chlorite and magnetite. A metamorphosed layered intrusion more than 600 m thick occurs in a greenstone succession west of Navy Board Inlet and contains ultramafic rocks, gabbro, and anorthositic gabbro (Jackson et al., 1985).

Mixed rocks (3)

Distinct, variously layered rocks (including lit-par-lit gneiss) of highly variable composition make up most of the crystalline complex as well as this map unit. Commonly, the layers range from a fraction of a centimetre to a few hundred metres thick. Most layers are concordant but a significant proportion, chiefly of granitic composition, range from slightly to, locally, highly discordant. Most of the discordant layers are probably intrusions, but some may have been emplaced tectonically. Medium grained rocks are most abundant. Commonly, light grey or white to light grey, medium pinkish grey, and pink bands alternate with medium to dark grey, greenish-grey, brown and black bands. Biotite, hornblende, hypersthene, clinopyroxene, garnet and magnetite, are common mafic minerals. Corundum and spinel occur locally.

Most light coloured bands are mineralogically syeno-granite to granodiorite, massive to foliated, and sharply to gradationally bounded. The bands include granitic intrusions, pegmatites and aplites, as well as metasediments, and possibly acidic volcanics. A few sill-like granite and charnockite bodies up to about 1000 m wide, occur locally; anorthositic layers are rare. Minor feldspathic quartzite and locally, calc-silicates, are also present.

The dark layers comprise paragneiss (e.g. biotite + hornblende ± garnet ± pyroxene), amphibolite, and minor pyroxenite, metagabbro, and ultramafic rocks.

Other rock types present in this map unit include nebulitic, fluidal, boudinaged, augen, porphyroblastic, blasto-porphyritic, blastomylonitic and agmatitic gneisses.

These mixed rocks resulted from the injection of igneous material into metasedimentary and metavolcanic strata, anatexis and intense deformation. The various lithologies are intruded by felsic to mafic and rare ultramafic dykes.

Meta-anorthosite, mangerite-jotunite (4)

Several small bodies of metamorphosed anorthositic and related mafic rocks occur within the map area, however only those on central Bylot Island, which may be genetically related to the charnockitic Bylot Batholith (Jackson and Davidson, 1975), are shown on Map 1-1987.

The meta-anorthosite is white, massive, fine grained to coarsely pegmatitic, and contains minor garnet and quartz. Mangerite (hypersthene monzonite)-jotunite (hypersthene monzodiorite) also occurs in the same area. It is mottled light grey and black, fine- to medium-grained, blastoporphyritic, sheared, lineated, and finely foliated. Hornblende, hypersthene, clinopyroxene, biotite, magnetite and quartz are common. Minor meta-hypersthene pyroxenite (norite) and charnockite occur with the meta-anorthosite and mangerite-jotunite.

Foliated to locally massive granitoid (including charnockitic) rocks (5)

A large, U-shaped, foliated, charnockitic plutonic complex called the Bylot Batholith occupies 2600 km^2 of northeastern Bylot Island. Elsewhere, small foliated granitic bodies up to 20 km long are scattered sparsely throughout the map area. They are chiefly granite-granodiorite, but include a few charnockitic bodies.

The granitoid rocks are fine- to coarse-grained and foliated to locally layered or massive. They are highly deformed, sheared, lineated, blastoporphyritic to blasto-mylonitic, and porphyroblastic, the megacrysts being chiefly feldspar. Clinopyroxene, hornblende, garnet, and biotite are common mafic minerals. Hypersthene and magnetite are also common in the charnockites and epidote in the granites.

Most of the charnockites are hypersthene monzo-granite (monzo-charnockite), but range from hypersthene syeno-granite (syeno-charnockite) to hypersthene granodiorite (charno-enderbite). Hypersthene syenite (syeno-mangerite) – hypersthene syenodiorite (jotunite) occurs locally. The charnockites are greasy grey to green, light yellowish green, and buff to light brown. Some charnockitic sills and dykes occur predominantly in granulite facies migmatites.

The granitic bodies are chiefly pink to greyish pink monzo-granite but range from syeno-granite to granodiorite. Syenite and monzonite are rare.

The charnockites and foliated granites are chiefly metamorphosed, possibly anorogenic intrusions emplaced no later than the mid-Aphebian, and possibly as early as late Archean. The charnockitic rocks, especially, probably include some highly recrystallized basement rocks that predate the intrusions.

Massive granite-granodiorite (6)

Massive granitic dykes, sills and small plutons, of granite-granodiorite composition, but chiefly monzo-granite, occur in all other map units of the crystalline complex. Only a few bodies are large enough to show separately on the map, although they form anywhere from less than one per cent of the outcrop to anastomosing networks comprising 80 per cent of the outcrop. Typically these rocks are massive, pale to medium pink, and fine- to coarse-grained. Pegmatitic and aplitic varieties are uncommon, and white and foliated varieties occur locally.

These rocks are rarely deformed, but, locally at least, have been metamorphosed (most obvious in granulite facies). They are thought to have been emplaced in the late Aphebian, and may be a late-stage expression of the Moranian Orogeny (Stockwell, 1982). They may be correlative with larger massive granites to the south (Jackson et al., 1978b).

Structures

Structural patterns are extremely variable and complicated within the Archean-Aphebian Complex. Within the eastern part of the map area the complex is cored by a huge, intricate, arcuate (U-shaped) synformal structure that

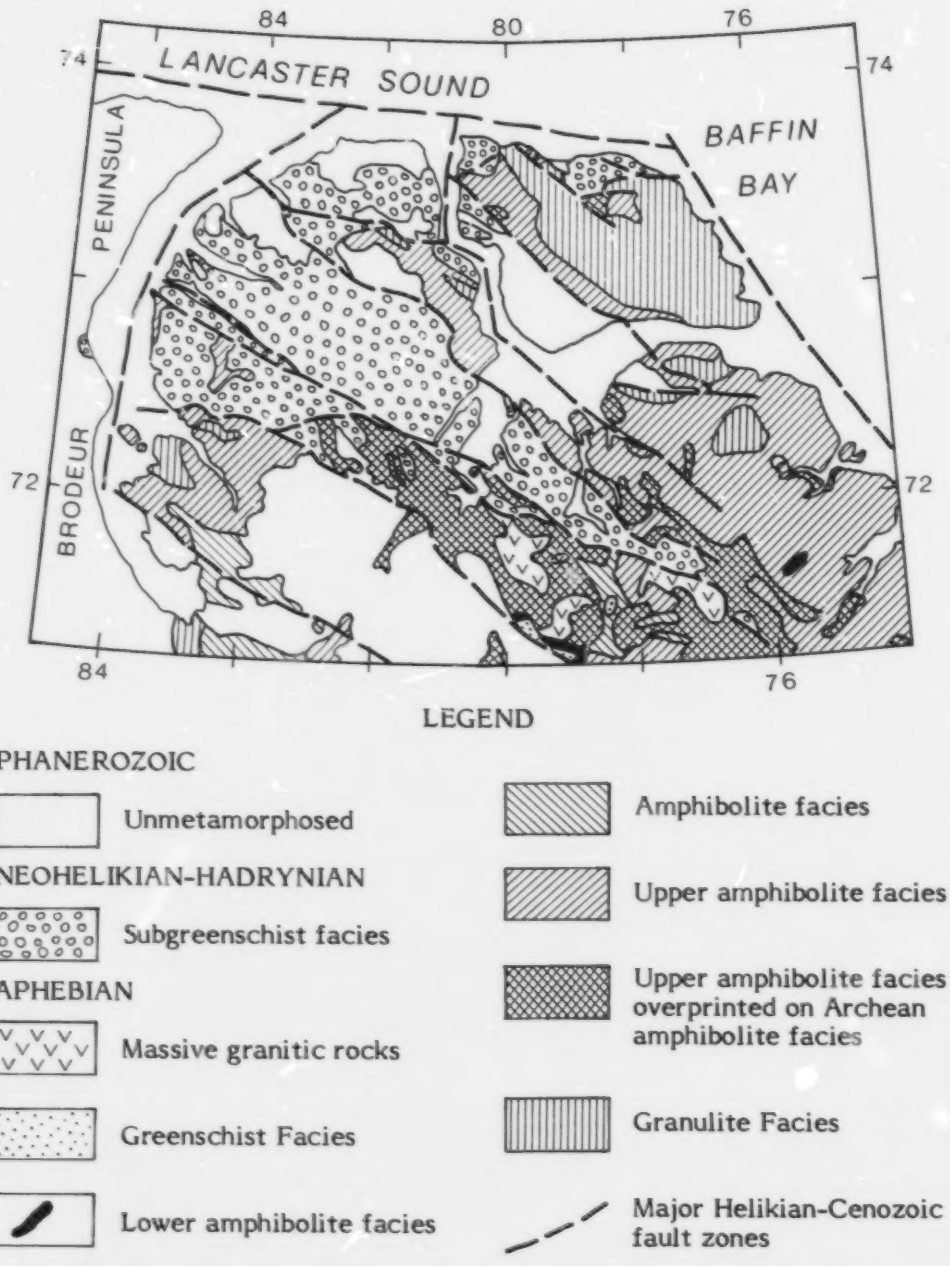


Figure 2. Regional metamorphism in study area (modified from Fraser et al., 1978).

includes the Bylot Batholith and which plunges 20-25° northwest. The Bylot Batholith seems to occupy the axial zone of a refolded antiform whose northern extremities plunge northwest. The arcuate structure becomes more diverse and poorly defined south and east of Oliver Sound.

The western limb of the arcuate structure is highly sheared, and contains tight, undulating, isoclinal recumbent folds overturned chiefly to the southwest, which probably include nappes with associated thrusts (Jackson and Davidson, 1975; Jackson et al., 1975). The recumbent folds extend around the southern end of the arcuate structure and trend mainly easterly to northeasterly in the southeast part of the map area.

The presence of refolded folds, tightly folded pegmatites, pegmatites intruding late massive monzo-granite which in turn intrudes migmatite, highly metamorphosed gabbro dykes and sills, and granitic intrusions metamorphosed to various degrees, all indicate at least two major periods of deformation and metamorphism.

Metamorphism, age determinations

Upper amphibolite facies regional metamorphism predominates throughout most of the Archean-Aphebian Complex, and in part has been superimposed on pre-existing amphibolite facies rocks (Fig. 2; Fraser et al., 1978; Jackson and Morgan, 1978). Granulite facies predominates on Bylot

Island, but only underlies a few isolated patches elsewhere. A small area between Milne and Admiralty inlets contains undifferentiated greenschist to upper amphibolite facies rocks.

Rb-Sr isochron and errorchron metamorphic ages (unpublished) of 2256-2389 Ma have been obtained for three components (considered separately and combined) of a basement gneiss on the east side of Admiralty Inlet just west of the map area. In addition, Rb-Sr isochron and errorchron metamorphic ages of 2476-2642 Ma have been obtained for basement gneisses in the Mary River area of the Icebound Lake map area to the south (Jackson, 1978; Jackson et al., 1978b). Mary River Group strata in the same area have yielded a metamorphic Rb-Sr isochron age of 1971 Ma. Zircons from basement gneisses on Devon Island northwest of the map area have yielded a U-Pb concordia age of 2426 Ma (Frisch, 1983).

Nearly two dozen mineral and whole-rock K-Ar ages have been determined for Archean-Aphebian gneisses from Devon Island on the north, to the Mary River region (in 37G) on Baffin Island just south of the map area (Blackadar, 1970; Frisch, 1983; Jackson, 1978; Jackson and Davidson, 1975; Jackson and Morgan, 1978; Jackson et al., 1978b; Wanless, 1970). The three oldest ages are 2016, 1975 and 1865 Ma; the three youngest are 1525, 1590 and 1610 Ma. The rest lie between 1655 and 1785 Ma.

The determined ages delineate four events about 300 million years apart. Preliminary conclusions are that three orogenic events probably affected the map area about 2600-2700, 2300-2400 and 1970-2070 Ma ago. The oldest event corresponds in age with the Laurentian Orogeny and the youngest with the Moranian Orogeny (Stockwell, 1982). A fourth event, 1650-1800 Ma ago, may be more of an epeirogenic uplift event related to orogenesis on southern Baffin Island and elsewhere during the Hudsonian Orogeny.

Neohelikian Borden Rift Basin

Introduction

As much as 6100 m of late Proterozoic (Neohelikian) strata are exposed in spectacular towering castellated cliffs of rugged, mountainous northern Baffin and Bylot islands (Table I). These strata nonconformably overlie an Archean-Aphebian gneiss complex, are intruded by Hadrynian, Borden and Franklin diabase dykes, and are overlain unconformably by Paleozoic and Cretaceous-Eocene strata. Lemon and Blackadar (1963) and Blackadar (1970) documented early exploratory work, established the stratigraphic succession, and defined the formations. Other recent studies include those by Blackadar et al. (1968a-e), Galley (1978), Galley et al. (1983), Geldsetzer (1973a, b), Graf (1974), Iannelli (1979), Jackson and Davidson (1975), Jackson and Cumming (1981), Jackson and Iannelli (1981), Jackson et al. (1975, 1978a, b, 1980, 1985), Olson (1977, 1984) and Sangster (1981).

The gneisses are commonly stained red for several metres below the unconformity, and up to 6 m of regolithic material is preserved south and east of the head of Tremblay Sound, in the Paquet Bay area and on Bylot Island. In these areas basement gneisses pass gradually upward into friable, varicoloured, massive to poorly stratified rocks that consist essentially of recessive masses of kaolinized feldspar and more resistant granular layers and lenses of quartz, all in a finely crystalline chloritic matrix. The contact between the regolith and basal Neohelikian strata is unconformable and planar to slightly undulatory. Where the regolith is absent, the contact between the gneisses and overlying Neohelikian strata is also planar to undulatory, with a maximum observed relief of 2 m. Local draping and pinching-out of sedimentary beds occurs over the small basement topographic highs.

The Neohelikian succession was assigned to the Borden Basin by Christie et al. (1972), and has been named the Bylot Supergroup by Jackson and Iannelli (1981), who recognized three groups – lower clastic (Eqalulik), middle carbonate platform (Uluksan), and upper clastic (Nunatsiaq) that are commonly separated by intra-basinal disconformities (Table I).

Attempts to determine the age of the Bylot Supergroup have been reviewed briefly by Jackson and Iannelli (1981). The most reliable results are probably those of Fahrig et al. (1981), who concluded that Bylot Supergroup paleomagnetic poles are of Neohelikian age, because the Nauyat-Adams Sound pole is about 1220 Ma, and the Strathcona Sound pole (Table I) about 1203.5 Ma.

Eqalulik Group (7-10)

This group comprises the Nauyat, Adams Sound, Arctic Bay and Fabricius Fiord formations, each of which has been subdivided into members.

Nauyat Formation (7)

The Nauyat, lowermost formation of the Eqalulik Group (Table I), averages almost 240 m in thickness in the western part of the map area, and may be 430 m thick south of Adams Sound.

The Nauyat Formation is divided into a lower NA_1 and an upper NA_2 member. Nauyat quartzarenites are similar to those of the overlying Adams Sound Formation, and are included in the latter formation where NA_2 basalt flows and sills are absent. Nauyat volcanics are thickest along a line trending north-northeast through Elwin Icecap, thin southeastward, and do not occur east of Tremblay Sound.

The NA_1 member consists predominantly of multicoloured (chiefly buff to pink) quartzarenite interbedded with minor subarkose, lesser amounts of quartz granule-pebble conglomerate and siltstone, and rare shale. The subarkose and conglomerate beds are mainly in the basal part of the member; a thin conglomeratic unit commonly rests on basement gneisses. This member is characterized by conglomerate-based fining-upward cycles in the southwest corner of the map area. Small to medium trough and planar crossbeds are the most common sedimentary structures.

The NA_1 member is entirely quartzarenite south of Tremblay Sound and on northern Bylot Island. Elsewhere, a conformable volcanic subunit containing one or two amygdaloidal plateau basalt flows, similar to those in the NA_2 member, occurs sporadically in the middle part of the member. Locally, rare volcanic fragments occur in the overlying strata.

The member varies in thickness from 0 to more than 160 m in the western part of the area and increases in thickness to the northwest. The intra-member volcanics, where present, commonly vary from 20 to 60 m in thickness. The NA_1 member is sharply and conformably overlain by NA_2 volcanics.

The NA_2 member consists of a variable sequence of up to seven basalt flows and minor interflow sediments. It has a maximum thickness of about 200 m in the west, thins southeastward, and is 8 m thick south of Tremblay Sound and 30 m thick on northern Bylot Island. Southeastward, the number of flows decreases to one or two. NA_2 rocks on northern Bylot Island may include massive mafic sills. Where NA_1 strata are absent, the NA_2 volcanics rest directly on basement.

Individual flows are up to 60 m thick, fine grained, and dark green to green-grey. Most flows are increasingly amygdaloidal upward but the uppermost is massive and

Table I. Formations of Neohelikian Bylot Supergroup

		Franklin Intrusions: Diabase	
HADRYNIAN	GP	Intrusive Contact	
NEOHELIKIAN	NUNATSIAQ	Elwin Formation (470-1100 m):	EL_1: Quartzarenite, siltstone EL_2: Sandstone, siltstone, dolostone
		gradational	
		Strathcona Sound Formation (493-910 m+)	SS_6: SS_{1-5} lithologies interbedded SS_5: Polymictic conglomerate SS_4: Siltstone, greywacke SS_3: Arkose-greywacke, shale SS_2: Dolostone, dolostone conglomerate SS_1: Shale, siltstone
		gradational	
		Athole Point Formation (0-585 m) Limestone, sandstone, shale	
	gradational		gradational to unconformable
	ULUKSAN	Victor Bay Formation (156-735 m)	VB_2: Limestone, dolostone, flat pebble conglomerate VB_1: Shale, siltstone, sandstone, limestone
		conformable, abrupt to gradational	
		Society Cliffs Formation (263-856 m)	SC_2: Stromatolitic and massive dolostones
	chiefly unconformable?		
	EQALULIK	Fabricius Fiord Formation (400-2000 m+)	SC_1: Stromatolitic dolostone, shale, sandstone, gypsum
		FF_4: Arkose, conglomerate, dolostone FF_3: Subarkose, conglomerate FF_2: Shale, quartzarenite FF_1: Quartzarenite, shale	gradational to unconformable Arctic Bay Formation (180-770 m) AB_4: Shale, dolostone AB_3: Shale, siltstone AB_2: Shale, quartzarenite AB_1: Siltstone, quartzarenite
		conformable, abrupt to gradational	
		Adams Sound Formation (0-610 m)	
		AS_3: Quartzarenite, conglomerate, shale AS_2: Quartzarenite AS_1: Quartzarenite, conglomerate	AS_U: Quartzarenite AS_L: Quartzarenite, conglomerate
		conformable	
		Nauyat Formation (0-430 m)	NA_2: Plateau basalt NA_1: Quartzarenite, subarkose, basalt
	BYLOT SUPERGROUP	nonconformity	
ARCHEAN-APHEBIAN		Granitic gneiss basement complex: migmatite, foliated granitic rocks, granite, charnockite, supracrustal relicts	

ai -free. Although chemically the NA_1 and NA_2 flows ar ic tholeiites, they have been emplaced in a sub-at... environment (Galley, 1978; Galley et al., 1983). Columnar joints are common, and pillow-like features extremely rare. The volcanics are spatially related to the major fault zones (Fig. 3).

Thin, baked, interflow sediments are chiefly quartzarenite with some small-scale fining-upward cycles. Thinly laminated stromatolitic limestone, with minor iron-rich carbonate and chert, occur in the middle of the flow sequence.

The contact with the overlying Adams Sound Formation is sharp and apparently conformable, but local volcanic clastics, and one volcanic arenite layer in the superjacent quartzarenites suggest minor local erosion.

Adams Sound Formation (8)

This formation conformably overlies NA_2 volcanics wherever the latter are present, although a thin (8 cm) layer of volcanic arenite locally overlies the volcanics (Geldsetzer, 1973b). Elsewhere the Adams Sound rests upon basement gneisses. The formation ranges from 610 m thick on western Borden Peninsula, to 45 to 65 m east of Tremblay Sound, and is at least 415 m thick on northwestern Bylot Island (Map 1-1987).

The Adams Sound Formation consists predominantly of thin- to thick-bedded, rarely massive, quartzarenites, with minor interbedded subarkose, quartz-pebble conglomerate and rare siltstone and shale. Common sedimentary structures include current ripples, crossbeds, channel scours, etc.

Two broad regions of Adams Sound strata have been delineated on the basis of subtle changes in lithology, the nature of depositional cycles, and contained sedimentary structures. These regions are: Borden Peninsula, and the Eastern region (southeast of Milne Inlet, and Bylot Island).

The Adams Sound Formation on Borden Peninsula has been divided into three intergradational members. Most of the AS_1 member is buff to red, planar to crossbedded quartzarenite that contains minor interbedded and interlensed granular to pebbly quartzarenite, oligomictic to polymictic pebble to cobble orthoconglomerate, subarkose, siltstone and shale. Conglomeratic rocks occur mostly in the basal part of the member; clasts are predominantly quartz, but locally include quartzarenite, chert and gneiss. Some conglomerate occurs in basal parts of fining-up cycles. AS_1 thickness ranges from 130 m in the northwest to 8-16 m near Tremblay Sound.

The AS_2 member is dominantly buff to light pink quartzarenite in which thinning-and fining-upward cycles occur locally. This member thins from 128 m in the southwest to 33 m at Tremblay Sound.

The AS_3 member is chiefly white, light to dark grey and pink quartzarenite with interbeds and lenses of granular to pebbly quartzarenite, and quartz-pebble conglomerate. Thin shale and siltstone interbeds occur in the uppermost part of the member. Channels filled by quartzarenite-clast breccia and conglomerate occur locally. Fining- and thinning-upward cycles occur chiefly in southern Borden Peninsula. AS_3 strata are commonly 70-100 m thick.

Adams Sound strata in the Eastern Region are similar to those on Borden Peninsula, but are informally divided into lower (AS_L) and upper (AS_U) members. More than 415 m may be present on Bylot Island, but the Adams Sound Formation is commonly 65 m or less east of Milne Inlet. Fining-upward cycles occur throughout the formation in the Eastern Region, but thinning-upward cycles are restricted to Bylot Island.

Buff to pink, orange and purple strata dominate the AS_L member. Quartzarenite predominates on Bylot Island, whereas quartz-pebble to quartz-cobble orthoconglomerates predominate southeast of Milne Inlet where gneiss clasts decrease in abundance upward in the member. Thicknesses are typically 110-200 m on Bylot Island and 1-15 m southeast of Milne Inlet.

White to buff and brown-grey quartzarenite predominates in the AS_U member. Minor quartz-pebble conglomerate decreases in abundance upward. The AS_U member is 140-200 m thick on Bylot Island and 18-35 m southeast of Milne Inlet.

Arctic Bay Formation (9)

Shale, locally pyritiferous, is the predominant lithology, with siltstone and quartz arenite interbedded with shale in the lower part of the formation, and siltstone, dolostone and quartzarenite interbedded with shale in the upper part. The formation is 180 m thick at Arctic Bay, may be 1000-1500 m thick east of Milne Inlet, but commonly ranges from 500 to 770 m thick elsewhere. The lower contact with the Adams Sound Formation is conformable and gradational. A variety of sedimentary structures including crossbeds and ripple marks are common (Jackson and Iannelli, 1981). White gypsum efflorescence is common, and a strong petroliferous odour and black bituminous material occur locally, chiefly in the dolostone.

Four intergradational members are distinguished in the formation throughout the area. However, the entire formation is distinctly different southeast of Milne Inlet.

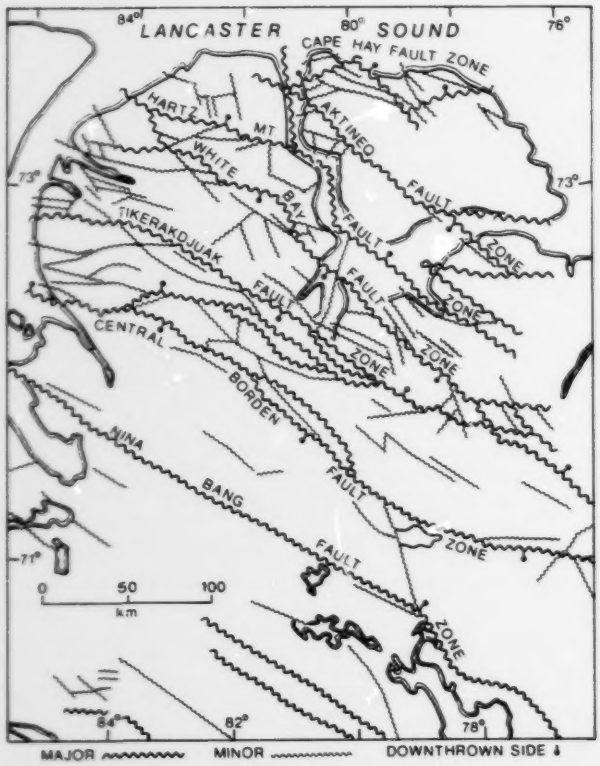


Figure 3. Fault zones on Bylot and northwestern Baffin Islands (from Jackson and Iannelli, 1981).

The AB_1 member comprises grey-green to white interbedded siltstone and quartz arenite and minor thin interlayers and partings of black shale that increase upward. Buff-white to grey quartzarenite with minor thin grey siltstone and shale interlayers and partings predominates east of Milne Inlet. Thicknesses range from 12-48 m.

The entire AB_2 member comprises as many as 16 coarsening-up cycles, each of which contains three intergradational units. Southeast of Milne Inlet the cycles are quartzarenite-dominated. Elsewhere they are shale-dominated. The lowermost unit of each cycle is chiefly black shale, the middle unit is interbedded grey-white siltstone, quartzarenite and shale, and the upper unit is grey-brown to grey and white quartzarenite. AB_2 member thicknesses range from 48-260 m.

Planar-laminated micaceous black shale predominates in the AB_3 member. Minor grey-black silty shale, siltstone, dololutite, and dolosiltite occur throughout and increase to 25 per cent of the member southeast of Milne Inlet where a 1 m concretionary limestone marker bed occurs in the middle of the member. There are few sedimentary structures. The AB_3 member is up to 400 m thick in the west, but only 64-92 m in the southeast.

Grey-black shale is the chief lithology of the AB_4 member except southeast of Milne Inlet where it is merely a prominent lithology and the member makes up most of the Arctic Bay Formation. Other common lithologies include limestone, dolostone, siltstone, stromatolitic dolostone, quartzarenite and arkose. The AB_4 member is more variable than other Arctic Bay members, and cyclical lithological sequences are common at most localities. All cycle types contain the same basic three-fold subdivisions present in AB_2 cycles. Member thicknesses are 370-615 m southeast of Milne Inlet, but are not more than 212 m elsewhere.

Shallowing-upward cycles occur throughout most of Borden Basin and contain a lower shale unit, a middle shale-calcisiltite or siltstone-quartzarenite-dolarenite unit and an upper limestone or siltstone-quartzarenite-dolostone unit. Coarsening-up cycles include: lower sandy shale grading upward into coarse conglomeratic arkose east of Milne Inlet, and shale-siltstone cycles in the northwest part of the map area that also contain minor pisolitic and concretionary to brecciated carbonate.

Fabricius Fiord Formation (10)

The Fabricius Fiord Formation outcrops chiefly in the southwestern part of the map area and in a few small isolated areas adjacent to major fault zones, some of which are not shown on Map 1-1987. Fabricius Fiord lithologies are undifferentiated from Arctic Bay locally on northwestern Bylot Island.

In general, the Fabricius Fiord Formation contains a lower sequence composed chiefly of black shale, grey to grey-white siltstone, and brown-grey to white quartzarenite in which the alternation of recessive and resistant beds gives a distinctive ribbed appearance to the outcrop, and an upper sequence composed predominantly of subarkose, conglomerate, and several minor lithologies. Locally the strata outcrop in large fan-shaped structures. Sedimentary structures are most abundant in the lower quartzarenites and siltstones and include crossbeds, ripple marks, etc. The Fabricius Fiord Formation ranges in thickness from 400 to more than 2000 m. Four intergradational members have been defined and three interlensing lithologic associations have been differentiated in the uppermost FF_4 member (Table I).

The contact with the underlying Adams Sound Formation is conformable and sharp to gradational. Fabricius Fiord strata are invariably downfaulted along, and/or marginal to major fault zones as along the Central Borden Fault Zone. The lower FF_1 and FF_2 members grade laterally northward (basinward) into facies-equivalent Arctic Bay strata. The FF_3 and FF_4 members are overlain disconformably by massive dolostone that closely resembles the Society Cliffs Formation (SC_2) in both lithology and contained stromatolites. Lenses (possibly biohermal) and thin beds of similar dolostone also occur within the FF_4 member. Therefore, although contact relations between upper Fabricius Fiord strata and lower Society Cliffs (SC_1) strata have not been seen, the two are considered tentatively to be facies equivalents.

The FF_1 member is chiefly white, rust-brown, and grey-green quartzarenite. Some subarkose occurs in the lower part in the east, whereas in the west the upper part consists of interbedded shale, siltstone and quartzarenite. Thicknesses range from 18 to 23 m.

The distinctive FF_2 member consists entirely of as many as 55 coarsening-up cycles. Each cycle contains three intergradational units that grade from predominantly shale in the lower unit to interbedded quartzarenite-siltstone-shale in the middle unit and quartzarenite in the upper unit. The member is 370-892 m thick.

The massive, resistant FF_3 member is mostly light grey to buff subarkose interbedded with some quartz- and quartz-feldspar-pebble conglomerate and quartzarenite. Poorly developed coarsening-up cycles are best developed in the west. Sedimentary structures are rare. The member is 736-840 m thick.

The FF_4 member occurs adjacent to the Central Borden Fault Zone, and individual beds locally increase in thickness towards the fault zone. The member is 150-245 m thick and has been divided into three laterally and vertically intergradational lithological associations. Sedimentary structures are relatively uncommon. The FF_4 member comprises more than 65 per cent of the FF_{4A} association, the rest consisting of scattered lenticular zones of FF_{4B} association and unstratified FF_{4C} wedges adjacent to the Central Borden Fault Zone. FF_{4B} and FF_{4C} associations occur at various stratigraphic positions within FF_{4A}. Both the FF_{4A} and FF_{4B} associations weather a diagnostic chocolate brown colour due to breakdown of contained iron-rich carbonate.

The FF_{4A} association is mostly chocolate brown (with less grey to yellow-brown and red-orange) subarkose, and pebbly subarkose with minor interbeds of arkose and pebbly arkose. The strata commonly have a calcareous matrix.

Carbonate-rich strata, chiefly stromatolitic dolostone and massive gritty dolostone, predominate in the FF_{4B} association. Some calcareous arkose-subarkose and flat pebble conglomerate are also present.

The entire FF_{4C} association comprises structureless, massive breccia-conglomerate wedges up to 5 m thick adjacent to the Central Borden Fault Zone, but which wedge out within 5 km north of the fault zone. Quartz and granitoid, granule to boulder sized clasts are supported in a dolostone matrix.

Uluksan Group (11-12)

The Uluksan Group includes the strata of the Society Cliffs and Victor Bay formations, which together with the Nauyat are the Bylot Supergroup strata that can probably

best be correlated with strata in other regions. Because of differences in group stratigraphy the Society Cliffs-Victor Bay contact in Eclipse Trough of northern Borden Peninsula and western Bylot Island may not coincide precisely with the stratigraphic position of the contact in Milne Inlet Trough to the south (Jackson et al., 1985).

Society Cliffs Formation (11)

Most of the formation consists of several types of laterally and vertically interfingering grey to brownish grey, light buff weathering dolostones that commonly emit a petroliferous odour and contain fine laminae and/or sparsely disseminated small blebs of bituminous material.

The major dolostone lithologies, in order of decreasing abundance, are:

1. Thick-bedded to massive dolostone.
2. Regularly laminated algal dolostone (cryptalgal laminite) to thin-bedded dolostone.
3. Nodular to ellipsoidal, irregularly laminated dolostone.
4. Dolostone conglomerate and breccia.

The dolostones include dololutite, dolosiltite, dolarenite and dolorudite. Dololutite and dolosiltite appear relatively more abundant in SC_1 member, whereas cryptalgal laminites (2) are more abundant in SC_2.

Interbedded with the dolostones, mostly in the lower part of the formation, are lesser amounts of quartzarenite, arkose, varicoloured shale, and gypsum. Limestone lenses and beds, and black to grey, thinly bedded to nodular chert are scattered throughout the formation. Varicoloured chert, primarily replacing stromatolitic dolostone, is locally abundant in the east, closely associated with redbeds and sabkha sequences.

Sedimentary structures are abundant (Jackson and Iannelli, 1981). Although stromatolites are abundant throughout the formation, bioherms are most common in the upper part of the formation in the Milne Inlet region. Conglomerates, breccias, tepee and other dewatering structures, and molar tooth, are also common.

The basal contact with the underlying Arctic Bay Formation ranges from conformable and sharp to unconformable with a dolostone-clast or limestone-clast conglomerate at the base. The Society Cliffs Formation overlaps basement gneisses locally along the White Bay Fault Zone (Fig. 3). The contact with the overlying Victor Bay Formation is conformable and sharp to gradational, and the shale content in the Society Cliffs locally increases upward in the uppermost few metres.

An abrupt vertical change in the terrigenous clastic content of the Society Cliffs Formation permits its division into two intergradational members: a lower, SC_1 member containing abundant terrigenous clastics, and an upper, SC_2 member with minor terrigenous detritus. Major carbonate lithologies are similar in both members. The formation thickens from 260 m at Arctic Bay to 856 m in the Milne Inlet region.

Most of the SC_1 member consists of shallowing-up cycles composed of two intergradational units, a lower unit of terrigenous and/or dolostone clastics and an upper stromatolitic dolostone unit with local shale. Gypsum occurs in the upper unit of redbed evaporitic cycles in the eastern part of the basin. The SC_1 member is 10-15 m thick in the western part of Borden Basin where it is a minor part of the formation. It thickens abruptly in the east where it constitutes most of the formation and is up to 480 m thick.

Throughout most of the Borden Basin the terrigenous clastics are chiefly white to light grey quartzarenite, sublitharenite, arkose, and dolomitic quartz-feldspar granule conglomerate, with minor local grey to black shale. Locally adjacent to the White Bay Fault Zone in the eastern part of the basin, the terrigenous clastics are varicoloured, and polymictic conglomerate clasts include granitic and dolomite granules and cobbles.

Evaporitic redbed sequences in SC_1 consist of green, red, and black shale with interbedded grey-green and pink dolostone and white gypsum. Salt casts occur sporadically. Individual gypsum beds, commonly less than 1.5 m thick, range up to 3 m thick on northern Bylot Island, where locally 60 gypsum beds occur in a 610-m-thick zone (Jackson et al., 1985). Elsewhere, gypsiferous coatings, gypsum casts, and crystal aggregates ("desert roses") occur locally in the dolostones.

The SC_2 member consists predominantly of the four major buff to brownish grey dolostone lithologies listed above. Rare terrigenous clastics are almost entirely shale. Poorly defined fining-, coarsening-, shallowing-, thickening-, and thinning-upward cycles are locally common. The SC_2 member ranges in thickness from 30 m to more than 600 m.

Victor Bay Formation (12)

The Victor Bay Formation consists primarily of various interbedded dark shales, siltstones, dolostones and coarse carbonate clastics. A petroliferous odour is common in the formation in eastern and northern Borden Basin. The major lithologies are commonly interbedded in sequences that differ from one another in thickness of beds, the major lithology, the relative proportions of contained lithologies, and their cyclical nature. Victor Bay strata range from 160 m at Arctic Bay to 730 m east of Milne Inlet.

The contact between the Victor Bay Formation and the overlying Strathcona Sound or Athole Point formations is variable. A dolostone flat boulder conglomerate up to 6 m thick occurs locally in the Victor Bay Formation at or near the contact with both overlying formations. A carbonate, round-boulder conglomerate bed up to 10 m thick, is common at or a short distance above this same contact in both overlying formations. The Victor Bay-Athole Point contact appears conformable and gradational to abrupt. The Victor Bay-Strathcona Sound contact ranges from gradational and sharply conformable to unconformable.

Most of the Victor Bay Formation south of the White Bay Fault Zone (Fig. 3) is divisible into two locally intergradational members: a lower shale-dominated (VB_1) and an upper carbonate (VB_2) member.

The VB_1 member is limited almost entirely to the Milne Inlet Trough (Fig. 4) and widens abruptly southward from the White Bay Fault Zone. Sedimentary structures are varied but rare (Jackson and Iannelli, 1981). The member has a maximum thickness of about 370 m east of the head of Strathcona Sound.

Predominant VB_1 lithologies are grey, brownish-grey or black, laminated to thin-bedded, locally pyritiferous shale, siltstone, limestone, and dolostone. Minor lithologies include siliciclastic carbonates, graphitic shale, quartzarenite, quartzwacke, and subarkose. Individual carbonate beds and carbonate-dominated units commonly increase in number and thickness upward in the member, as does the proportion of dolostone to limestone. Some sequences, interpreted as having been deposited in a shallowing upward environment, consist of basal shale that grades upward through interbedded carbonate and shale to carbonate or carbonate clast

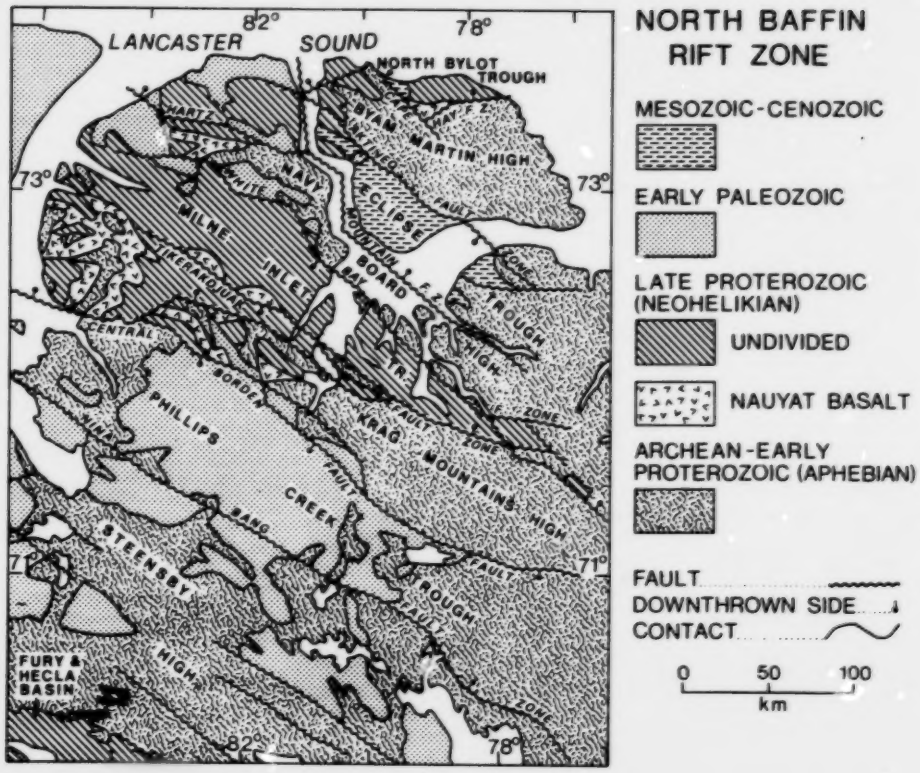


Figure 4

North Baffin Rift Zone
(from Jackson and Iannelli, 1981).

conglomerate at the top. Others are thickening-upward, thinning-upward, and a few are deepening-upward cycles. The shale content of the VB_1 member is markedly less in the eastern and western ends of Milne Inlet Trough where the member is almost entirely dark grey to black limestone- and dolostone-cryptalgal laminites.

The VB_2 member is present everywhere in the formation and constitutes the entire formation north of Milne Inlet Trough (Fig. 4). Grey, brownish-grey to black and white clastic carbonates constitute most of the VB_2 member and are similar to those of the Society Cliffs Formation, but commonly contain more disseminated terrigeneous clay, silt and sand. Laminated to thin-bedded carbonates dominate, but thicker-bedded and lumpy (nodular)-bedded, carbonates as well as cryptalgal laminites are common. Carbonate flat-clast conglomerates are abundant in the south and rare in the northwest. Carbonates within the Milne Inlet Trough are chiefly limestone in the lower part of the member and dolostone in the upper part. Dolostone predominates throughout the member to the north.

Terrigeneous clastics form a minor component, the predominant lithology of which is grey to black, locally pyritiferous shale. Siltstone, siliciclastic dolostone and sandstone are also present. Shallowing-up sequences and a few deepening-up sequences are present. Sedimentary structures are common (Jackson and Iannelli, 1981), and include stromatolites, flat clast conglomerate, molar tooth, etc. The stromatolites are most common in the eastern part of Borden Basin.

Nunatsiaq Group (13-17)

Strata overlying the Victor Bay Formation are assigned to the Nunatsiaq Group, which includes the Athole Point, Strathcona Sound and Elwin formations (Table I). Except for the Athole Point Formation, the group is dominated by terrigenous clastics.

Athole Point Formation (13)

The Athole Point is composed chiefly of various dark-coloured limestones interbedded with subordinate siliciclastic limestones, calcareous siltstones, and sandstones in variously interbedded sequences. The limestones typically have a petroliferous odour. The Athole Point ranges from 525 to 585 m in thickness. It consists of three intergradational members, AP_1 to AP_3.

The lower part of the AP_1 member consists predominantly of interbedded, thinly-laminated to medium-bedded calcilutites and calcisiltites, in part stromatolitic. These limestones commonly contain shaly or silty terrigenous material and some are siliciclastic. Limestone cryptalgal laminites and lumpy-bedded limestones are common. Minor limestone-, flat- and round-clast conglomerate, calcareous sandstone, and orange-weathering siliceous limestone also occur.

Fining-up sequences include complete and incomplete Bouma cycles, and are particularly common in the upper part of AP_1 member. Rare coarsening-upward conglomeratic cycles occur near the base. The AP_1 member is 127-210 m thick.

The AP_2 member consists almost entirely of cryptalgal laminite limestone interbedded with units of laminated to thin-bedded limestone. The limestones are calcilutites and calcisiltites, and bedding is planar to undulatory. The lower part of the member coarsens slightly upward and is dark grey to brown and black. A few thin siliciclastic limestone and orange-weathering limestone beds separate the lower and upper parts of the member. The AP_2 member is 90-124 m thick.

Most of the upper AP_3 member (190-370 m thick) consists of interbedded units of planar to undulose, thinly-laminated to very thick-bedded, grey to brown and black limestone, cryptalgal laminite limestone, and calcareous sandstone. Sporadic orange-weathering limestone beds are

locally excellent marker horizons. Minor limestone lithologies include lumpy-bedded strata, flat-clast breccia, and chip to boulder breccia. Limestones are dominantly calcilutites and calcisiltites with subordinate calcarenite, and many contain locally reddish shale and siltstone.

The AP_3 member contains numerous fining-up cycles, and a few coarsening-up cycles. Locally there is an overall coarsening upward, with a sympathetic increase in terrigenous clastics. Turbidite sequences are abundant.

Sedimentary structures are most common in the AP_3 member and least common in the AP_2 member. Those common throughout the AP_1 and AP_3 members include: graded beds and Bouma cycles, flutes and load casts, flame structures, crossbeds, etc. Stromatolites and small bioherms are also common.

Strathcona Sound Formation (14-16)

This formation comprises a wide variety of complexly interfingering lithologies. These are mainly laminated to thin-bedded shales and siltstones, thin- to very thick-bedded sandstones, stromatolitic dolostones, dolostone conglomerates, and polymictic conglomerates. These various lithologies occur singly, or interbedded with others, in units up to 110 m thick. The contact between the Strathcona Sound and Victor Bay formations varies from conformable (abrupt to gradational) to disconformable. Contacts of the Strathcona Sound with the laterally equivalent Athole Point Formation and the overlying Elwin Formation are conformable and gradational. Strathcona Sound strata interfinger with and overlie Athole Point strata.

The Strathcona Sound Formation has been subdivided into six intergradational members (Jackson and Iannelli, 1981; Table I). Only two, however, are typically present: a lower shale-siltstone member (SS_1), and an upper arkose-greywacke-siltstone member (SS_3). The formation is estimated to exceed 910 m in thickness in Milne Inlet Trough, but is commonly about 500 m in Eclipse Trough.

The greatest variety of sedimentary structures occurs in SS_1 and SS_3 members, and includes: ripples, crossbeds, flutes, flames, load casts, etc. (Jackson and Iannelli, 1981). Relatively few structures are common in SS_5 member and they are rare in both the SS_2 and SS_4. Oolites and pisolites occur locally.

The SS_6 member, which occurs chiefly on northwestern Bylot Island (14-16 undivided), consists essentially of SS_{1-5} lithologies too finely interbedded to be differentiated. The remaining five members have been arranged in three map units as follows:

unit 16 = SS_3 - SS_5 members
unit 15 = SS_1 member
unit 14 = SS_2 member

Map unit 14 (SS_2 member) is composed almost entirely of dolostones. Light grey, stromatolitic dolostone predominates. Locally, stromatolites are rare and interbeds of breccia, round-clast and flat-pebble conglomerate, and shaly dolostone with local synaeresis cracks are present.

The biohermal part of the unit is conformable and gradational with the underlying Victor Bay Formation. Map unit 14 strata laterally interfinger with, and are locally overlain by, map unit 15 (SS_1) red shale and siltstone. Map unit 14 may be at least 300 m thick.

Laterally the central part of map unit 14 is composed mostly of elliptical, narrow, elongate bioherms up to 1 km long and 120 m thick. Easterly and northeasterly elongations predominate. Each bioherm is developed from a number of coalescing growth centres 2-5 m high.

The marginal areas of unit 14 are predominantly oligomictic to polymictic boulder orthoconglomerates and breccias which occur in irregular lenses interbedded with dolostone, siltstone and shale. Most clasts are dolostones derived from the Victor Bay, Society Cliffs, and from upper Victor Bay-lower Strathcona Sound biohermal carbonates, but granitic gneiss boulders occur locally.

Olistoliths, up to 1 km long and underlain by olistostromes, occur just west of the map area, and were probably derived from the Society Cliffs Formation to the south.

Red to red-brown or locally grey to green interbedded calcareous shales and siltstones predominate in map unit 15 (SS_1 member). Very fine-grained arkose and subordinate litharenite are locally abundant. Carbonate and various sandstone lithologies occur sporadically throughout the unit. The carbonate, in part stromatolitic, is chiefly dolostone in central Borden Peninsula and limestone to the northwest and southeast. Fining- and thinning-upward cycles occur at several localities.

Carbonate-clast orthoconglomerates are common in the lower part of the unit, particularly at or a short distance above the base of the unit. Clast rounding increases westerly and easterly away from the centre of Borden Peninsula. In general, degree of rounding and proportion of shale, silt and gneiss clasts increase upward, and gneiss clasts commonly predominate in conglomerates in the upper part of the unit.

Map unit 15 (SS_1 member) is best developed south and north of Navy Board High on Borden Peninsula (Fig. 1), and constitutes most of the formation in the latter locality. It is laterally intergradational with units 14 and 16 and with the Athole Point Formation. Unit 15 red siltstone overlies karsted Victor Bay dolostone south of Elwin Ice Cap. Relationships with unit 16 vary from interfingering and intergradational to unconformable. Predominantly, unit 16 overlies unit 15. Measured partial sections indicate a maximum thickness of more than 348 m for map unit 15.

Map unit 16 (SS_3 - SS_5 members) is composed mostly of grey to green, red to pink, locally red-brown, sandstones interbedded with conglomerates, siltstones, shales, and locally with minor dolostones and limestones. Most sandstones and conglomerates are calcite-cemented, and sandstones are chiefly lithic arenites and arkoses. Oolites, pisolites and frosted sand grains are common in the upper part and disseminated pyrite occurs locally.

The conglomerates are polymictic orthoconglomerates in which granitic gneiss, quartz and feldspar are the predominant clasts, but sandstone, siltstone, shale, and carbonate clasts are common. Conglomerate clasts occur locally.

The SS_4 member constitutes most of the exposed Strathcona Sound Formation west of Baillarge Bay, and is chiefly a monotonous succession of laminated grey calcareous siltstones interbedded with minor grey subarkose and feldspathic wacke, and a few thin carbonate beds.

Conglomerates (SS_5 member) constitute virtually the entire Strathcona Sound Formation along the White Bay Fault Zone (Fig. 4) where they are concentrated in fans which grade away from the fault zone into more typical Strathcona Sound and Athole Point strata. Paraconglomerates and oligomictic conglomerates are present in addition to the polymictic orthoconglomerates.

Unit 16 strata occur chiefly in interbedded cyclic packets of fining-upward units. Shoaling-up, coarsening-up, thinning-up, and thickening-up cycles are also present. Basal beds commonly rest on scoured surfaces and locally conglomerates fill channels. In addition, thinning-up cycles

are common, and some coarsen upward. Locally, a disconformity within map unit 16 may divide lower fine-grained varied lithologies and upper coarse calcareous feldspathic wacke. The feldspathic wacke lies disconformably on Victor Bay strata in the vicinity of Strathcona Sound, occurs at progressively higher stratigraphic positions toward the northeast, grades laterally into and interfingers with other Strathcona Sound strata, and interfingers laterally with and conformably overlies Athole Point Formation.

The contact of map unit 16 with the overlying Elwin Formation is gradational. Partial sections indicate the unit is commonly more than 410 m thick. Locally, it may constitute the entire formation.

Elwin Formation (17)

The Elwin, uppermost formation of the Nunatsiaq Group, is composed of varicoloured quartz-rich sandstones, with minor siltstones, dolostones and shales. The sandstones are equigranular and generally contain even less matrix than those of the Strathcona Sound. Frosted sand grains, cross-beds, ripple marks and several other structures are common throughout the formation.

The Elwin Formation is conformable and gradational with the underlying Strathcona Sound Formation. The contact is difficult to define, but is commonly marked by the abrupt appearance of quartzarenite, and a slight but distinct diminution in sandstone grain size. The Elwin is overlain unconformably by lower Paleozoic strata, ranges in thickness from 870 to 1100 m, and is divided into two intergradational members comprising nine sub-members.

The lower EL_1 member (265-375 m thick) is composed of interbedded red, grey-green, white and buff subarkoses, quartzarenites, lithic arenites, siltstones, dolostones, and intraformational doloru dite. Commonly, the sandstones contain kaolinized feldspar. Stromatolitic dolostone is rare. Pisolites and halite casts occur locally. Depositional cycles in EL_1 are common, but are not as apparent as in the underlying Strathcona Sound Formation. Cycles include thinning-up (bedding), thickening-up, coarsening-up (grain), fining-up, and shallowing-up. Compound cycles contain at least two of the above types in a single cycle.

The upper EL_2 member is predominantly white to light grey, buff to orange and light-green quartzarenites interbedded with minor siltstones and shales. The sandstones are finer grained, better sorted and more mature than sandstones in the lower member. Most siltstones and shales are black in the lower part of the member and grey in the upper part. Where present, cyclic deposition is vague, ill-defined, and constitutes a few graded beds and coarsening-up cycles. The EL_2 member may be as much as 850 m thick.

Evolution of Borden Basin

Faulting

Faulting, predominantly along northwest-trending faults (Fig. 3), has taken place in northwest Baffin Island from the end of Aphebian to Recent time (Jackson et al., 1975, 1978a, 1985; Jackson and Morgan, 1978). Several small northwest-dipping, low-angle thrusts may be mainly syndepositional but may also be related to postdepositional compression from the northwest.

Most of the faulting during deposition of the Bylot Supergroup occurred as vertical movements along steep northwest-trending faults. Movements were episodic and culminated during deposition of the Arctic Bay-Fabricius Fiord formations and later during Strathcona Sound-Athole Point deposition.

Major blocks within the Milne Inlet Trough have been tilted to the northeast and southwest. This suggests that the main boundary faults are listric faults. Indications of wrench faulting are inconclusive. Although considered to be of negligible importance during formation of the Borden Rift Basin in the Neohelikian, wrench faulting may have been significant at other times. The following points were considered.

i) Faults and fold structures within the Bylot Supergroup resemble those formed during wrench faulting but the indicated direction of movement is contradictory, and similar folds occur in the Paleozoic and Cretaceous-Eocene strata.

ii) Distribution of Archean Mary River Group iron-formation is most compatible with negligible lateral movement, but might be indicative of 10-30 km of right lateral apparent separation along the Central Borden Fault Zone.

iii) Alignment of Hadrynian diabase dykes indicates negligible lateral movement since their emplacement. Bylot Supergroup strata may have been mildly warped before and after dyke emplacement.

iv) Distribution of boulder types in the Strathcona Sound Formation fanglomerates is inconclusive, but is compatible with vertical movement along the White Bay Fault Zone.

v) Metamorphic isograds do not appear to be horizontally offset along the main faults.

Northerly to northeasterly trending faults were much less widespread and of relatively local extent during sedimentation. A hinge zone or/and active fault zone was located along Milne and Navy Board inlets throughout sedimentation. Alignment of this zone with the east margins of Devon and Ellesmere islands and Nares Strait suggests vertical movement may have occurred along this linear in Neohelikian time. Deposition of Strathcona Sound facies in Milne Inlet Trough was probably controlled in part by northeast-trending faults.

The present fault distribution and nature of the North Baffin Rift Zone (Fig. 4) probably approximates the nature of horst and graben development at the close of Elwin deposition, although much faulting postdates Bylot Supergroup deposition. A negative Bouger gravity anomaly coincides with a few thousand metres of the Cretaceous-Eocene Eclipse Group on southwestern Bylot Island. This suggests that here the Eclipse Group may be underlain by Paleozoic and/or Neohelikian strata, and that this part of the Eclipse Trough was further downdropped during or after deposition of the Eclipse Group. Lancaster Sound may have been a graben area within the North Baffin Rift Zone, although the present graben (Kerr, 1980) may have a more easterly trend than the Neohelikian one.

Filling of the Basin

Deposition of Bylot Supergroup commenced with faulting, terrigenous clastic sedimentation and basic volcanism (Eqalulik Group) during initial marine transgression across a northwesterly dipping peneplane developed on the Archean-Aphebian granitoid basement complex. Later broad downwarping resulted in regional shallow marine carbonate sedimentation (Uluksan Group). Continued downwarping resulted in renewed faulting, collapse, and mild compression, and finally, basin stability (Nunatsiaq Group). Presence of a marine basin to the northwest is indicated during most of Bylot Supergroup deposition.

The dominantly braided, fluvial sandstones of the lower Nauyat and Adams Sound formations accumulated in a narrow channel southeast of Milne Inlet that may have originated by faulting. This channel is transitional into an alluvial plain delineated by an anastomosing network of upward-coalescing braided stream deposits. Lower Nauyat strata in the northern part of the basin were deposited in mixed fluvial to marginal-marine environments.

On a regional scale, sedimentation was interrupted by quiescent extrusion of southeast-thinning Nauyat terrestrial tholeiitic plateau basalts. These were not deposited in the southeastern part of the basin. The present distribution of the flows is determined by major northwesterly trending faults. However, northwestward thickening of the volcanics suggests that the erupting fissures may equally well have had a northeasterly trend. Renewed sedimentation rapidly buried the volcanics beneath prograding braided fluvial clastics before appreciable erosion or incision.

Throughout deposition of the Adams Sound Formation, fluvial environments predominated in the southeast part of the basin, whereas mixed fluvial and marginal marine environments predominated in the northeast. In the western (north and south) part of the basin fluvial sedimentation occurred throughout AS_1 deposition and mixed fluvial and marginal marine sedimentation occurred during AS_{2-3} deposition.

Periodic regional subsidence was accompanied by marine transgression until marine sedimentation prevailed during deposition of the interfingering and intergradational Fabricius Fiord and Arctic Bay formations. Lower Fabricius Fiord (FF_1) coastal and shallow shelf sediments accumulated along the southern margin of the basin. Coeval lower Arctic Bay (AB_1) intertidal sediments were deposited in the southeast and mixed intertidal to shallow subtidal clastics were deposited in the rest of the basin.

Major intrabasinal faulting and extrabasinal uplift began late during lower Arctic Bay-Fabricius Fiord deposition, and continued sporadically throughout deposition of both formations. The most pronounced effect of this faulting and uplift was in the southern part of the basin, where large coalescing marine-influenced delta fan complexes (FF_{2-4}) were deposited along the Central Borden Fault Zone. These fan complexes extended upward and northward to interfinger with lower Society Cliffs strata.

While these Fabricius Fiord delta-fan complexes formed, the coeval Arctic Bay member (AB_2) was deposited in marine-influenced deltas and on clastic shorelines in the southeast, and in a shelf environment elsewhere. The AB_3 member accumulated in a subtidal, locally starved, basin environment. AB_4 strata, including deltaic-alluvial fan complexes, were deposited in shallower mixed clastic shoreline and shelf environments.

The upward-increasing carbonates in the Arctic Bay are precursors of the thick platformal carbonates of the Society Cliffs and Victor Bay formations. However, the disconformity common at the base of the Society Cliffs suggests that faulting or regional warping may have played a major role in changing the nature of sedimentation.

Carbonate shelf environments were maintained throughout most of the basin during deposition of the Society Cliffs, with subtidal to intertidal sedimentation predominating. Syndepositional faulting produced local karst topography and elevated the proto-Navy Board and Byam Martin highs. Terrigenous clastics shed from these highs accumulated in alluvial plain and intertidal to supratidal or sabkha environments, and are interbedded with dolostones throughout most of the eastern Society Cliffs Formation.

Downfaulting of the Milne Inlet Trough, accompanied by a sagging of the south-central part of the basin at the beginning of Victor Bay sedimentation, resulted in deposition of a northward-thinning tongue of subtidal shale. Elsewhere, intertidal to supratidal, with rare subtidal, carbonate deposition predominated. Thickest accumulation during Society Cliffs, Victor Bay, and possibly Athole Point-lower Strathcona Sound sedimentation was in the Milne Inlet area.

Major syndepositional faulting tilted the Milne Inlet and Eclipse Trough depositional floors toward Navy Board High during accumulation of the Strathcona Sound and Athole Point formations, resulting in a variety of local and regional depositional environments and interfingering lithologies. With uplift of the Navy Board and Byam Martin highs, previously deposited sandstones and carbonates were eroded from the Navy Board High and a thick sequence of coarsely conglomeratic coalescing alluvial fan complexes (SS_5) were deposited south of the White Bay Fault Zone (Fig. 4) during virtually the entire Strathcona Sound depositional period. At the same time, finer grained, varied sediments (SS_6) were deposited in the north-central part of the basin, and a monotonous sequence of turbidite clastics (SS_4) accumulated in a down-dropped area in the central western part of the basin.

Faulting during lower Strathcona Sound deposition involved northward down-tilting of the Milne Inlet Trough and scissor-type movement between the Trough and Navy Board High. This resulted in deposition of lacustrine or shallow marine limestones in the lower SS_5 member adjacent to the Navy Board High. It also resulted in deposition of the predominantly intertidal-subtidal Athole Point limestones with turbidites and minor interbedded debris flow conglomerates in the southeastern part of the basin. Athole Point strata were buried by marine sands that are probably distal equivalents of both the SS_5 alluvial fan complexes to the north and the upper Strathcona (SS_3) submarine fan deposits to the west.

In the northern and south-central parts of the Borden Basin, lower Strathcona Sound (SS_1) strata, interpreted previously by Jackson and Ianelli (1981), as intertidal and overbank alluvial deposits, are probably largely submarine fan deposits (Jackson et al., 1978a; Jackson and Iannelli, in press). They contain scattered channel deposits and debris flow breccia and conglomerate lenses. An isolated, small, subtidal-intertidal biohermal reef complex (SS_2) developed rapidly in the west-central part of the basin proximally to a growth fault, east of the SS_4 member, during deposition of lower Strathcona Sound sediments. Syndepositional faulting shed prograding SS_1 clastics westward, terminating carbonate platform development.

SS_1, SS_2 and Athole Point strata interfinger with and are overlain by upper Strathcona Sound (SS_3) strata. Coarse grained conglomeratic and channelled SS_3 sandstones occupy an elongated belt that trends northeast from the east end of Strathcona Sound. SS_3 strata become finer grained northeastward along the belt, laterally away from the belt, and grade westward into SS_4 strata. SS_3 strata north of Navy Board High are similar to SS_4 strata. Most SS_3 and SS_4 strata probably represent a submarine fan complex that was deposited penecontemporaneously with, and over-rode the SS_1 fan complexes to the northeast (Jackson and Iannelli, in press). Uplift of the area south of the Central Borden Fault Zone (Steensby High) probably provided the detritus for this fan complex. While the eastern Milne Inlet Trough was probably connected to a westerly sea during most of Strathcona Sound deposition, this connection may have been temporarily restricted or closed during deposition of SS_3 strata.

Strathcona Sound strata on southeastern Devon Island (Fig. 4) rest unconformably on basement gneisses (G.M. Narbonne, personal communication, 1979). This suggests that this area may have been a source area during deposition of much of the Bylot Supergroup although fault-initiated uplift along Lancaster Sound may also have stripped earlier Bylot strata and redeposited them elsewhere.

Waning source area uplift and minimal subsidence during lower Elwin Formation deposition in intertidal to supratidal environments was superseded by deposition of relatively clean and well-sorted deeper water sands of the upper Elwin. A western source area may have been present during lower Elwin deposition, and the Devon High may have been present during upper Elwin deposition.

Metamorphism

The Nauyat volcanics, and probably most of the rest of the Bylot Supergroup have undergone subgreenschist facies metamorphism (Jackson and Morgan, 1978). The age of this metamorphism is uncertain. However, the mean of 17 whole rock K-Ar Nauyat volcanic ages is 946 Ma, and a 6-point Rb-Sr errorchron has yielded an age of 1129 Ma with an initial intercept of 0.7120 and a MSWD of 5.5 (Jackson and Iannelli, 1981). It is inferred tentatively from these ages that the subgreenschist metamorphism occurred about 900-1100 Ma ago.

Origin

Borden Basin evolved within the North Baffin Rift Zone, in which movement along dominantly vertical northwest-trending faults, probably from the close of Aphebian to Recent time, resulted in formation of several horsts and grabens (Fig. 4). Borden Basin probably developed along a failed arm or aulacogen, as first suggested by Olsen (1977), during a mid-late Proterozoic ocean-opening as proposed by Trettin et al. (1972). Jackson and Iannelli (1981) concurred with Olson and Trettin et al., and named the ocean formed by the opening (1200-1250 Ma ago) the Poseidon Ocean. Doming and crustal extension accompanied by early faulting initiated the aulacogen. There may have been some movement of Greenland away from North America at this time (Jackson et al., 1985)

An Rb-Sr isochron age of 1060 Ma, and U-Pb zircon ages of 926 and 980 Ma from gneisses on northwestern Ellesmere Island have been tentatively related to a 1000 Ma ("Grenvillian") igneous intrusion and/or regional metamorphism event (Sinha and Frisch, 1975, 1976; Trettin and Balkwill, 1979). Presence of southeast-dipping thrusts, and Trettin's (1983) suggestion that the gneisses may be allochthonous, strengthen the possiblity that these gneisses may be related to a 1000 Ma closing of the Poseidon Ocean. The subgeenschist metamorphism and a few small-scale northwest-dipping thrusts in the Bylot Supergroup may also be related to this "closing".

Hadrynian Diabase Dykes

Northwest-trending tholeiitic diabase dykes (Christie and Fahrig, 1983; Fahrig et al., 1971, 1981; Fahrig and Schwarz, 1973; Jackson and Iannelli, 1981) cut all other Precambrian rocks of the map area (Fig. 5), postdate some folding and faulting of the Bylot Supergroup, and are overlain nonconformably by Phanerozoic strata. Traces of sulphides are associated with some of the dykes.

These dykes were formerly, considered to be 750 Ma old Franklin dykes. Based on their paleomagnetic data, however, Christie and Fahrig (1983) have concluded that a second older swarm, the 950 Ma Borden dykes, is present and that dykes younger than the Franklin dykes are also present. In addition, one or two of the earlier pole positions are reported by Fahrig et al. (sites 10, 11, 23; 1971) to be Mackenzie poles. These "Hadrynian" dykes therefore may range in age from Neohelikian to late Hadrynian. K-Ar ages for diabases within the map area range from 470 to 819 Ma, and are of little use in differentiating Borden from Franklin dykes (Christie and Fahrig, 1983; Jackson and Iannelli, 1981). No diabase dykes are known to intrude Phanerozoic strata in this region.

The Hadrynian dykes are in general less altered than the Nauyat volcanics and most may have escaped subgreenschist facies metamorphism. Chemically the dykes are more highly differentiated than the volcanics.

Many of the Hadrynian dykes were emplaced along fault zones and dominant northwest-trending dykes are concentrated along the Tikerakdjuak Fault Zone (Fig. 4). Some subordinate, thinner, northerly trending dykes cut northwest-trending dykes, and most, if not all, of these younger dykes seem to be Franklin. Some northerly trending dykes seem to be co-intrusive with and to simply splay off the main northwest trending dykes. The two trends probably developed in response to brittle fracturing of a block related to tension and torsion caused by movement along bounding fault zones. Borden dykes may have been emplaced in a tensional regime that superseded the closing of the Poseidon Ocean about 1000 Ma ago.

Early Paleozoic Basin and Shelf Sediments (18-21)

As much as 1040 m of early Paleozoic sediments are preserved in the map area (Table II), and have been separated here into three map units (18-20) that locally are undivided (map unit 21). These strata were deposited on an erosion surface across which the relations vary from a regional disconformity to an angular unconformity, and a nonconformity. A thin regolith underlies the Paleozoic strata locally. The following information is derived chiefly from reports by Trettin (1969, 1975; see also Blackadar, 1968a, 1968b, and Lemon and Blackadar, 1963). Locally, these strata are undivided (map unit 21).

Cambrian and/or Early Ordovician

Admiralty Group (18)

The Admiralty Group comprises the clastic Gallery Formation and the overlying clastic and dolomitic Turner Cliffs Formation. Thickness of the group in the map area may range from 80 to 460 m. Locally a thin regolithic zone, as much as 1-2 m thick, caps basement gneisses underlying the Gallery Formation in the Mary River area.

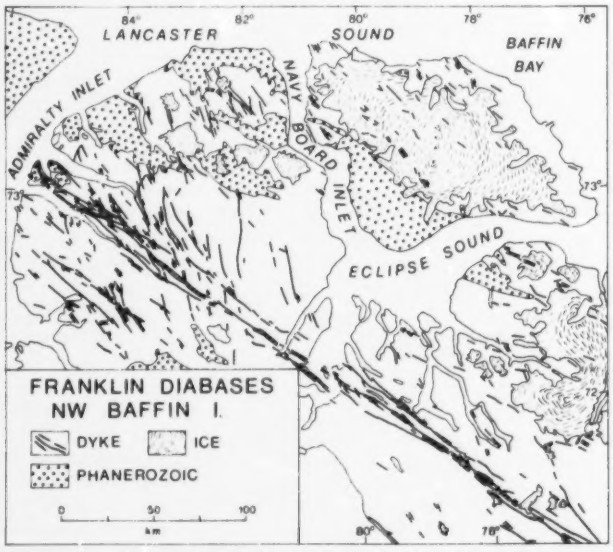


Figure 5. Hadrynian diabase dykes, Bylot and northwestern Baffin Islands (from Jackson and Iannelli, 1981).

Table II. Early Paleozoic Formations (modified slightly from Trettin, 1969)

Age	Group	Formation and thickness (metres)	Lithology
Late Middle Ordovician to Middle Silurian	Brodeur	Baillarge (120-140)	Dolomitic limestone; minor calcareous dolomite, shaly carbonates, shale
	Local or Regional Disconformity		
Early and early Middle Ordovician		Ship Point (60-305)	Dolomite, in part shaly and silty; minor quartzose sandstone, dolomitic sandstone, dolomitic intraformational conglomerate, siltstone, sandstone, and shale
	Contact Relationships Uncertain		
		Turner Cliffs (12-250)	Dolomite, mostly shaly and silty; quartzose and dolomitic sandstone; intraformational conglomerate; minor siltstone, shale, sparse oolitic iron oxides
Cambrian and/or Early Ordovician	Admiralty		Minor hiatus?
		Gallery (0-343)	Quartzose and minor dolomitic sandstone; minor siltstone, shale, conglomerate, a little breccia, dolomite
	Disconformity to Nonconformity		
Precambrian			Igneous, metamorphic, sedimentary, and volcanic rocks

The Gallery Formation consists mainly of crossbedded quartzose sandstone with small proportions of siltstone, conglomerate, breccia, shale, and dolostone. Breccia and conglomerate are most abundant in the lower, predominantly red, part of the formation. The upper part of the formation is predominantly grey. Orange, light- to yellowish-grey, and green chloritic strata are also present in the formation which is 0-343 m thick in the map area. Fossils are apparently absent.

The Turner Cliffs Formation comprises two alternating assemblages:

1. Yellowish-grey quartzose – and dolomitic – sandstones, with some greenish chloritic and glauconitic rocks and rare red sandstones. The latter contain oolitic iron oxides at one locality. Crossbeds are common and concretions are scattered sparsely throughout.
2. Shaly, silty, to sandy microcrystalline dolostone is the most abundant lithology and is chiefly light shades of grey, yellow and green. Reddish to purplish hues occur locally. Minor intraformational flat-clast conglomerate, dolomitic siltstone, shale, and sandstone are common. Authigenic pyrite, and glauconite occur locally and the assemblage is fossiliferous.

Six members have been established in the northern part of the map area, but cannot be identified in the southern part where lithologic units are more variable and lenticular. The Turner Cliffs Formation is about 12-250 m thick. It overlies the Gallery Formation at a conformable abrupt contact that probably marks a minor disconformity.

Early and Early Middle Ordovician

Ship Point Formation (19)

The Ship Point Formation was redefined by Trettin (1975) to contain two apparently conformable members. The lower, Member A, is a widespread sandstone unit that is similar to assemblage 1 in the Turner Cliffs Formation, but is relatively rich in dolostone. Member A is about 5-55 m thick in the map area. Member B, much thicker than A, is chiefly pure yellowish-grey microcrystalline dolostone. Minor lithologies are light grey to light green and include dolomitic intraformational flat-clast conglomerate and rocks, with varying amounts of siliciclastic material, that range in composition from dolostone to dolomitic quartz sandstone, dolomitic siltstone, and shale. Bituminous and carbonaceous matter, authigenic pyrite, glauconite, and fossiliferous oolitic beds occur locally.

The formation is about 60-305 m thick. Its contact with the underlying Turner Cliffs Formation appears conformable, but may be a disconformity that represents a major hiatus.

Late Middle Ordovician to Middle Silurian

Brodeur Group (20)

The Baillarge Formation, the only representative of the Brodeur Group in the map area, has been divided into lower (A) and upper (B) members. In the Arctic Bay area, member A consists mainly of thinly interlayered mixtures of limestone and penecontemporaneous dolostone, both microcrystalline, and a few beds of completely dolomitized fossiliferous limestone. Only grey shaly limestone, partly dolomitized in some areas, has been recognized in member A elsewhere within the map area, but other lithologies may be present. Member B is composed of cryptocrystalline limestone partly replaced by micro- to fine-crystalline dolomite. The limestone is dark reddish to yellowish brown, emits a strong fetid odour, and contains a few greenish argillaceous interbeds. The lower part of this member contains the Arctic Ordovician fauna.

The Baillarge Formation is at least 140 m thick north of Arctic Bay, and is probably less than 120 m thick elsewhere in the map area. Member A thins eastward from 85 m north of Arctic Bay to a very few tens of metres in the rest of the map area. Where seen, the Baillarge overlies the Ship Point Formation at an abrupt, conformable contact that appears to represent a disconformity. A solution zone is present locally in uppermost Ship Point strata on northern Borden Peninsula.

Origin

The Admiralty Group was deposited in the Admiralty Basin, centred on eastern Borden Peninsula north of the Milne Inlet deposition centre of the Neohelikian Uluksan and Nunatsiq groups. Admiralty deposition kept pace with subsidence, although the eastern extent of the basin is not known. Gallery strata consist mainly of fluvial deposits and the overlying Turner Cliffs strata are mainly shallow marine intertidal deposits.

Overlying Ship Point and Baillarge strata were deposited chiefly in a shallow marine shelf environment, being mainly intertidal during Ship Point deposition and shallow subtidal during Baillarge deposition. However, sediments, also deposited locally in very shallow waters with restricted circulation, perhaps in lagoons, are also present in the Baillarge Formation. In general, dolomitization was penecontemporaneous with deposition.

Faulting was active during early Paleozoic deposition and Trettin (1969) concluded that positive movements occurred along Navy Board High (Fig. 4) between Ship Point and Baillarge deposition. Faults, chiefly trending northwest, are prevalent in and adjacent to the Paleozoic strata. Some faults in Precambrian rocks are truncated at the contact with overlying Paleozoic strata.

Cretaceous-Eocene fault-related sediments

Eclipse Group (22)

The Eclipse Group of Bylot and northwestern Baffin islands (Jackson et al., 1975; Jackson and Davidson, 1975) has long been of interest because of the coal seams it contains. Recently Miall et al. (1980) have provided much additional data, improved the mapping of these strata considerably on southwestern Bylot Island, and correlated the strata with three formations (Table III) elsewhere in the Arctic. The isolated nature of these strata (the closest equivalent strata are the Eureka Sound Formation ca. 400 km to northwest on west-central Devon Island) makes correlations and the inferred continuous nature of such formations uncertain. Therefore, it is not only appropriate but advisable to retain the term Eclipse Group to refer to the remnants of these strata in the map area which are preserved chiefly in two basins – the Eclipse and North Bylot troughs.

Contact relations of the Eclipse Group with the underlying Precambrian rocks are similar to those between the early Paleozoic and Precambrian. The Eclipse Group may be underlain by Paleozoic strata on southwest Bylot Island. Miall et al. (1980) have correlated Eclipse Group strata with the Hassel, Kanguk and Eureka Sound formations, separated from one another by disconformities (Table III), and concluded that about 3000 m of these commonly fossiliferous strata are exposed in Eclipse Trough (Fig. 4) on southwest Bylot Island. Only the basal Hassel Formation occurs on adjacent Baffin Island, but the Hassel and at least part of the Kanguk Formation is probably present in a small area on northern Bylot Island which was not visited by Miall et al. (1980). The following descriptions are chiefly from Miall et al. (1980).

Hassel Formation

The basal Hassel Formation is composed chiefly of weakly cemented white to locally buff-orange, and dark reddish-brown, quartzarenite. Crossbeds and pyritiferous concretions also occur locally. Minor grey to greenish shale or mudstone and siltstone, red shale, black shale, and rare pebble conglomerate are also present. Seams and lenses of sub-bituminous coal are most abundant at Salmon River, southwest of Pond Inlet, where as many as six seams have been reported, and individual seams are up to 2 m thick. According to Miall et al. (1980) the Hassel Formation probably ranges from 10 to 120 m in thickness, and an Albanian to Cenomanian age is indicated.

Kanguk Formation

The Kanguk Formation has been divided into two members on southwest Bylot Island. The lower, mudstone member (575 m) is soft grey, locally jarositic, mudstone. Siderite concretions are common and glauconite sandstone beds occur near the base.

The upper, sandstone member (0-540 m) outcrops only from Aktineq Glacier southeast to Sermilik Glacier and is composed of white, orange or pale brown, friable, rarely crossbedded, immature sandstone. Minor siltstone, mudstone, and conglomerate lenses are also present.

The mudstone member is probably Campanian-Maastrichtian in age, and the sandstone member is Maastrichtian in age (Miall et al., 1980).

Table III. Cretaceous-Tertiary Eclipse Group of Eclipse Trough (modified slightly from Miall et al., 1980)

Age	Formation	Member	Thickness (m)	Lithology
Late Paleocene-Early Eocene	Eureka Sound	Upper mudstone	200+	mudstone, minor sandstone
		Upper sandstone	1370+	immature sandstone, minor siltstone, mudstone
		Lower mudstone	80-500+	mudstone, jarositic, minor sandstone
		Lower sandstone	0-200	glaconitic quartz-arenite
		Disconformity		
Campanian-Maastrichtian (Late Cretaceous)	Kanguk	Sandstone	0-540	immature sandstone, minor siltstone, mudstone
		Mudstone	560-590	mudstone
		Disconformity		
Albian-Cenomanian (Middle Cretaceous)	Hassel		10-120	quartzarenite, minor mudstone

Eureka Sound Formation

The Eureka Sound Formation has been divided into four members by Miall et al. (1980), some of which are, in part, laterally equivalent. The lower sandstone member (0-200 m) occurs only locally and is characterized by white quartzose glauconitic fossiliferous quartzarenite with rare thin carbonaceous silty shale beds.

The lower mudstone member (80-500 m+) overlies the lower sandstone member abruptly and is composed of dark grey, jarositic silty mudstone containing siderite concretions and carbonate-cemented sandstone lenses. The upper part of the lower mudstone member contains interlayered sand beds in coarsening-up cycles, and grades into the overlying upper sandstone member. Ripple marks, load casts, groove casts, roots and leaf impressions are abundant in the sand beds (Miall et al., 1980).

The upper sandstone member (1370 m+) is composed chiefly of white, orange, or brown sandstone. Rare silty or argillaceous beds occur mainly near the base, where channel cutbacks and pebble- to boulder-conglomerate beds are present. Structures are rare but mudstone intraclasts and liquefaction features are common in the member.

The upper mudstone member (200 m+) is dark grey carbonaceous mudstone with rare concretionary sandstone lenses. This and the underlying upper sandstone member are intergradational.

The Eureka Sound Formation is considered to be of Paleocene to Eocene age.

Origin

The following conclusions, unless stated otherwise, are excerpts from Miall et al. (1980).

The Hassel Formation is interpreted as a fluvial deposit probably formed chiefly by a series of local tributaries that may or may not have converged into a major trunk stream. The northeast boundary of Eclipse Trough became active (reactivated?) at this time, at least in part, as a syndepositional fold or fault.

The lower, mudstone member of the Kanguk Formation represents a Late Cretaceous marine transgression. The upper sandstone member is largely a braided stream deposit formed in response to appearance of a local sediment source, possibly as a result of faulting (writer). Regional uplift or drop in sea level terminated sedimentation at the close of the Cretaceous, when the Eclipse Trough was tilted gently southwestward.

Marine transgression resulted in deposition of the locally distributed lower sandstone member of the Eureka Sound Formation as a shoreline deposit. Transgression proceeded more rapidly during deposition of the lower mudstone member which grades upward into river-dominated deltaic deposits, formed as streams prograded. These sediments in turn grade upward into the predominantly braided stream fluvial upper sandstone member, deposited by a northwestward prograding alluvial system. Renewed Eocene marine transgression resulted in deposition of the upper mudstone member.

During and/or following deposition, the Cretaceous-Eocene strata were gently tilted and folded, at least locally (Jackson and Davidson, 1975; Jackson et al., 1975; Miall et al., 1980).

Cretaceous-Eocene sedimentation within the map area occurred at least partly in response to renewed faulting and reactivation of pre-existing structures within the North Baffin Rift Zone that may have originated near the close of Aphebian time (Jackson and Davidson, 1975; Jackson et al., 1975; Jackson and Iannelli, 1981). Miall et al. (1980) related the series of fault-controlled basins containing Cretaceous-Tertiary deposits along the margins of both sides of Baffin Bay-Labrador Sea to crustal attenuation, possibly accompanied by seafloor spreading, during the Cretaceous-middle Eocene Eurekan rifting episode.

Pleistocene – Recent (23)

Unconsolidated deposits of the area east of Milne and Navy Board Inlets have been studied by Hodgson and Haselton (1974), and by Klassen (1981, 1982). Limited information for the map area is also available in some other papers such as those by Blackadar (1970), Craig (1965), Falconer (1962), Jackson and Davidson (1975), and Jackson et al. (1975). A cassiterite glacial pebble was found in the area about 1920. Its origin is unknown, and the writers know of no other report of cassiterite or of concentrations of other economic minerals in the unconsolidated deposits.

According to Hodgson and Haselton (1974), the surficial deposits are largely coarse glacial till and fluvial deposits that are thickest and most varied at the heads of fiords (Cockburn Moraine System), and on the outer coast. The oldest moraines, presumably remnants of a continental ice sheet, occur on the Baffin Bay coastal foreland and on the shores of Navy Board Inlet and Lancaster Sound. The Cockburn Moraines, part of an extensive system in eastern Arctic Canada, are about 6300-8100 years old.

Thick sandur (alluvial outwash plains) deposits occur along stream valleys and fiords in the eastern part of the map area. They consist chiefly of coarse sand and gravels deposited along braided stream systems.

Glaciers and ice fields have expanded greatly in the recent past, as is evidenced by related end moraines, channels, and lichen trim lines (Hodgson and Haselton, 1974). Most ice fields and glaciers currently are receding from a recent post-continental glaciation maximum (op. cit.).

Klassen (1981) concluded that major ice sheets moved northward across Baffin Island onto Bylot Island, depositing glacial erratics up to 1130 m above sea level (m.a.s.l.). This advance was followed by the "last" glaciation which carried debris up to 550 m.a.s.l., at least 35 000 radiocarbon years ago. During this last glaciation, Klassen (1981) inferred, partly from distribution of erratics, including some of amygaloidal basalt, that one glacier moved northward through Milne Inlet and turned eastward to Pond Inlet; a second glacier flowed northward through Admiralty Inlet and then eastward down Lancaster Sound. However, on northern Bylot Island, agate occurs along joints in Nauyat basalt which may also be amygdaloidal. Although amygdaloidal basalt is probably most abundant along the east side of Admiralty Inlet, it also occurs in two zones that extend east-west virtually across Borden Peninsula. In addition, megascopically identical amygdaloidal basalt is abundant in the volcanics of the Thule Group north of Devon Island on both sides of Baffin Bay. Finally, small Bylot Island outliers of Bylot Supergroup strata may have been destroyed while, or subsequent to, providing erratics.

Some time after the "last" glaciation Bylot glaciers advanced 10-15 km beyond their present limits. Imbricate glaciotectonic thrust plates, composed of outwash sediments, occur in front of some Bylot glaciers, and one plate has a maximum radiocarbon age of 120 ± 80 years (Klassen, 1982).

Table IV. Metallic and non-metallic mineral occurrences, Bylot Island and northwest Baffin Island

Occurrence number	latitude	longitude	Commodity	Geology and remarks	Reference
1A 1B 1C	72°08'40" 72°03'50" 72°09'30"	78°45'40" 78°28'45" 78°52'15"	Fe-Ti	Magnetite – ilmenite, disseminated, up to 30% as bands in Archean and/or Aphebian granite gneiss and quartzite	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Company, 1970; Area 38-B-3.
2A	72°12'45"	79°18'	Pb-Zn	In dolomite and quartz sandstone; 200 to 300 m from major fault contact with Aphebian rocks (White Bay Fault Zone). Galena up to 2%. Sphalerite trace to 5%. Can be traced laterally for a few hundred metres (usually 1%). Host rocks interpreted to be part of Arctic Bay Formation in King Resources Co. report.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Company, 1970; Area 37-G-14.
2B	72°22'	79°39'	Pb-Zn	In Victor Bay Formation conglomeratic dolomite. Very minor galena-sphalerite in massive marcasite talus (White Bay Fault Zone).	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Company, 1970; Area 37-G-14.
2C	72°17'	79°30'	Pb-Zn	In Society Cliffs Formation. Minor galena-sphalerite (up to 5%); near White Bay Fault Zone.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Company, 1970; Area 37-G-14.
2D			Pb	In Society Cliffs Formation near White Bay Fault Zone.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Company, 1970; Area 37-G-14.
3	72°08'	79°25'	Cu	A semi-quantitative spectrographic analysis of red gypsiferous shale yielded 0.15% Cu (in Society Cliffs Formation)	Jackson, Davidson, and Morgan (1975), p. 13.
4	72°08' to 72°14'	79°00' to 79°45'	gypsum	In Society Cliffs Formation. Gypsum beds up to 1.5 m thick in at least two stratigraphic levels.	Jackson, Davidson, and Morgan (1975), p. 13.
5	72°30' (approx.)	80°05	fluorite	Purple fluorite occurs in fractures in upper Victor Bay Formation; exact location not known	Jackson, Davidson, and Morgan (1975), p. 13.
6A	72°37'	78°05'	Coal	Coal seams along Salmon River up to 2 m thick. Coal has a high fusain content, is of sub-bituminous rank, non-coking, and can be made into briquettes. Seams may be continuous and could be of considerable value due to proximity of Mary River iron deposits. Mined from 1954-63 at average 125 tons/year.	Jackson, Davidson, and Morgan (1975), p. 13-14. Pawlowski (1975), p. 136-138. Caine (1973), p. 9. Swartzman (1947a, 1947b).
6B	72°31'39"	78°25'49"	Coal	Similar to 6A	Jackson, Davidson and Morgan (1975), p. 13-14.
7	72°14'	81°29'45"	Pb(Zn-Cu)	In Arctic Bay Formation dolomite. Galena-sphalerite-malachite-chalcocite-bornite in minor amounts at several localities.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources, 1969, 1970; Reports 060745, 019504, 019505.
8A	72°25'45"	81°37'30"	Pb(Zn,F,Ba)	In Society Cliffs Formation dolomite. Two main zones, 150 and 120 m long, 30 to 90 m wide, strike northwest for 30 m. Galena between 1-2%, up to 10%.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1969, 1970; Reports 019504, 019505, 060745.
8B	72°27'	81°39'	Pb(Cu)	Disseminations in Society Cliffs Formation; galena, minor malachite, chalcocite, chalcopyrite.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745
9	72°28'	81°57'	Pb,Zn,Cu	In Society Cliffs Formation dolomite, near fault(s). Several occurrences of galena, sphalerite malachite.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745.
10	72°30'35"	82°06'45"	Pb,Zn,Cu,Ag	In Society Cliffs Formation dolomite, near Victoria Fault, within 60-90 m of Society Cliffs/Arctic Bay contact, occurrences over a strike length of 3000 m. In fifteen drillholes, best reported grade was 13.5 m of 2% Pb + Zn; 0.47% Cu across 9 m; 29g/tonne Ag (3 m). Galena, chalcopyrite, chalcocite, malachite, azurite, sphalerite reported.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1969, 1970; Reports 019504, 019505, 060745.
11	72°28'	82°09'	Pb	Disseminated galena in calcite-filled fractures in Society Cliffs dolomite	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745.
12	72°36'	82°09'	Pb(Zn)	In Society Cliffs dolomite, 15 m above Society Cliffs/Arctic Bay contact within 100 m of a diabase dyke.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1969; Reports 019504, 019505.
13	72°34'40"	81°56"	Pb(Zn)	Conformable galena, minor sphalerite in dolomite, near Society Cliffs/Arctic Bay contact.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745.
14A	72°25'13"	82°10'12"	Pb	Galena in Society Cliffs dolomite	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745.
14B	72°26'47"	82°13'14"	Pb	Galena in Society Cliffs dolomite	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745.
15	72°22'	82°08'	Cu	Chalcopyrite, malachite in Aphebian granite gneiss near fault	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745.
16	72°25'40"	82°21'30"	Pb	Galena in Society Cliffs dolomite	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1969, 1970; Report 060745.

Table IV (cont.)

Occurrence number	latitude	longitude	Commodity	Geology and remarks	Reference
17	72°27'30" (centroid)	82°45'45"	Pb	Disseminated galena in Society Cliffs dolomite	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1969, 1970; Reports 019505, 060745.
18	72°34'	82°59'	Pb(Zn)	Numerous minor galena (with rare sphalerite) occurrences in Society Cliffs dolomite	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745.
19	72°35'15"	83°07'	Pb-F	Galena and fluorite disseminated in Society Cliffs dolomite	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745.
20	72°44'30"	83°03'	Pb	Galena in Society Cliffs dolomite	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1970; Report 060745.
21A 21B	72°46'23" 72°46'23"	82°55' 82°42'20"	Pb-Zn(F)	Sphalerite, galena, minor fluorite as fracture fillings in Society Cliffs dolomite	Department of Indian Affairs and Northern Development; Assessment Reports; Global Arctic Islands Ltd., 1974; Report 080200.
22	72°46'10"	83°01'30"	Pb(Zn-Cu)	Galena (minor sphalerite-chalcocite) in Society Cliffs dolomite. Best of four drill holes yielded trace to 0.93% Pb, 0.79% Zn, 0.01% Cu over 3 m widths.	Department of Indian Affairs and Northern Development; Assessment Reports; King Resources Co., 1969, 1970; Reports 019505, 060745.
23	72°49'	83°08'	Pb-Zn	Sphalerite and galena as fracture fillings in Society Cliffs dolomite.	Department of Indian Affairs and Northern Development; Assessment Reports; Global Arctic Islands Ltd., 1974; Report 080200.
24	72°53'	83°35'	Zn-Pb	Numerous occurrences in Society Cliffs dolomite have been explored by drilling. Mineralization reported to be similar to that at Nanisivik mine.	Olson (1977) Department of Indian and Northern Affairs, Mineral Industry Report 1978, NWT, pp. 28-30.
25	72°58'30"	83°58'25"	Zn-Pb	Sphalerite and galena in Society Cliffs dolomite	Department of Indian and Northern Affairs, Mineral Industry Report 1978, NWT, p. 29.
26	72°47'15" (approximate)	80°50'	Zn	In quartz sandstone reportedly of Arctic Bay Formation, but map shown in Uranerz Assessment Report 061675 places the occurrence Aphebian Unit 3. Pyrite, minor spalerite occur over a stratigraphic interval of 8 m.	Department of Indian Affairs and Northern Development; Assessment Reports; Uranerz Exploration and Mining Ltd., 1978; Report 061675.
27	72°54'	78°18'35"	Coal	Sub-bituminous, non-coking, up to 2 m thick.	Jackson, Davidson, and Morgan (1975) p. 13-14. Caine (1973) p. 13.
28	73°14'	79°25'	Fe	Veinlets and small amounts of disseminated magnetite occur locally in Unit 3; up to 10% magnetite has been reported.	Jackson and Davidson (1975), p. 7.
29	73°18'	79°35'	Cu	Minor malachite staining (unit 3)?	Jackson and Davidson, p. 7.
30	73°15' (approx.)	80°20'	Coal	Thin beds of sub-bituminous rank	Caine (1973), p. 9.
31	73°40'	79°45'	Coal	Thin beds of sub-bituminous rank	Caine (1973), p. 9.
32	73°32'20" (approx.)	78°59'	Fe	Thin beds of siderite occur in the lowest part of the Arctic Bay Formation south of Maud Bight	Jackson and Davidson (1975), p. 7.
33	73°29' (centroid)	80°47'	gypsum	Thin gypsum beds occur at several horizons in the Society Cliffs Formation of northen and western Bylot Island. South of Tay Bay at least 60 beds range from 10 cm to 3 m thick.	Jackson and Davidson (1975), p. 7 Jackson and Cumming (1981)
34	73°37'	78°40'			Jackson, Innelli, Knight, and Lebel, 1985
35	72°48'	83°59'	Pb-Zn	Assays of Pb-Zn from one drillhole cutting a sulphide-rich zone (dominantly pyrite); in Society Cliffs dolomite (?)	Department of Indian Affairs and Northern Development, Assessment Reports; Nanisivik Mines Ltd., 1981; Report 081548.
36	72°55'	84°05'	Fe	Stratabound massive hematite near base of Society Cliffs dolomite, over a strike length of at least 1 to 1.5 miles; up to 50 feet thick.	Department of Indian Affairs and Northern Development, Assessment Reports; Global Arctic Islands Ltd., 1974; Report 080200.
37	72°59' (approximate)	84°57'	Cu	Extensive malachite staining of the Adams Sound Formation due to finely disseminated chalcopyrite/also malachite in Society Cliffs dolomite near gabbro dykes.	Blackadar, Davidson, and Trettin, 1968d and Department of Indian Affairs and Northern Development; Assessment Reports; Texas Gulf Sulphur, 1965. (Barry Group).
38	71°55'25" (approximate)	78°17'	Pb-Zn	Minor Galena – sphalerite in Society Cliffs dolomite.	Department of Indian Affairs and Northern Development, Assessment Reports; King Resources Co., 1970, (White Bay area).
39	71°46'20"	78°27'40"	Fe	Metamorphosed iron-formation; mainly oxide facies, abundant silicate facies; local carbonate facies.	Jackson, Morgan, and Davidson, 1978b.
40	71°53'30"	79°53'30"	Fe	Metamorphosed iron-formation; mainly oxide facies, abundant silicate facies; local carbonate facies.	Jackson, Morgan, and Davidson, 1978b.
41	73°01'	84°28'30"	Fe	Massive hematite in Society Cliffs dolomite	Olsen, R.A., 1977, p. 106
42	72°57'40"	84°01'20"	Fe	Massive hematite in Society Cliffs dolomite	Department of Indian Affairs and Northern Development, Assessment Reports; Global Arctic Islands Ltd., 1974; Report 080200. and Olson, R.A., 1977, p. 106.

MINERAL OCCURRENCES

Within study area

The known metallic and non-metallic occurrences in the study area, their location, the commodities of interest, and brief geological remarks, are listed in Table IV. Of the 51 known mineral occurrences in the study area, 27 (52.9%) are lead-zinc (barite, fluorite), 5 (9.8%) are coal, 4 (7.8%) are copper, 10 (19.6%) are iron, and 3 (5.9%) are gypsum.

Lead-Zinc (barite, fluorite)

Of the known lead-zinc (plus minor barite and fluorite) occurrences in the study area, fully 19 (79%) occur in the Society Cliffs Formation (unit 11, Map 1-1987), 3 (12.5%) are in the Arctic Bay Formation (map unit 9) and 2 (8.3%) are in the Victor Bay Formation (unit 12). Mineral exploration in the area has, of course, focused on the Society Cliffs Formation because it is the host rock to the Nanisivik lead-zinc mine. Consequently, in the absence of more comprehensive mineral exploration of the area, it is premature to conclude whether the abundance of lead-zinc occurrences in the Society Cliffs Formation relative to other formations is real or simply an artifact of exploration. It may be worthy of note that lead-zinc mineralization is hosted in successively older rocks in three locations in a northwest-southeast belt extending from the Polaris deposit on Little Cornwallis Island (Kerr, 1977), southeast to Nanisivik and on to the Mary River region. At Mary River the mineralization, admittedly sparse, is in Mary River Group, tectonized, rodded quartz-mica rock adjacent to the Central Borden Fault Zone (e.g. Jackson, 1966).

The Nanisivik deposit, occurring 22 km west of the western boundary of the study area (73°03'N; 84°30'30"W), has been in production since October, 1976. Current (February, 1987) reserves, including proven, probable, and possible ore categories, reserves are 4,250,000 tonnes at 9.68% Zn and 0.3% Pb. The deposit, consisting of a large main lens and several smaller subsidiary lenses, is a massive pyrite body with lesser sphalerite and galena within dolomites of the Upper Proterozoic (Helikian) Society Cliffs Formation (map unit 11). The main orebody, about 3000 m long, is discordant with respect to bedding in the host rock dolomite and is postulated to have formed by deposition of sulphides in a large cavity.

The sulphide bodies were emplaced some time after Victor Bay sedimentation and prior to Franklin dyke intrusion (see also: Agar and Farquharson, 1980; Clayton and Thorpe, 1982; Geldsetzer, 1973a,b; Graf, 1974; Olson, 1977, 1984; Sangster, 1981). It has been shown by Christie and Fahrig (1983) that there may be two ages of Hadrynian dykes on Borden Peninsula of about 750 and 950 Ma. If ore deposition is post-Bylot Supergroup metamorphism then deposition occurred either about 1000 Ma or 1000-750 Ma, depending on the age of the dykes intruding the ore.

A second large lead-zinc occurrence, that at Hawker Creek (72°53'N; 83°35'W) has received considerable attention by mineral exploration personnel and extends over an area 427 x 2878 m (Gibbins, 1979). The occurrence has been the object of geophysical, geochemical, and geological surveys, it has been trenched in several places, and 436 m of drilling were completed. One trench revealed 16 m of sulphide mineralization with an average grade of 15.4% Zn and 1.6% Pb, similar to that at Nanisivik Mine (Gibbins, 1979). Olson (1977) pointed out that mineralogy, texture, and mineral distribution at the Hawker Creek occurrence are remarkably similar to those at Nanisivik.

Copper

Minor copper occurrences, some no more than malachite stains, have been reported in basement gneisses and in Nauyat volcanics. A routine analysis of red gypsiferous shale of the Society Cliffs Formation yielded 0.15% Cu but little other information is available.

Copper minerals are also found in association with lead-zinc occurrences, especially those in Society Cliffs Formation. Of these, perhaps the most significant is the Surprise Creek occurrence (72°30'35"N; 82°06'45"W). Here, fifteen holes were drilled, totalling 1976 m, to examine Pb-Zn-Cu mineralization in a tectonic breccia in Society Cliffs dolomite. Copper intersections up to 0.59% across 4.2 m were encountered.

Iron

Disseminated magnetite has been reported at two localities in basement granite gneisses. Both occurrences appear, from ground examination and aeromagnetic surveys, to be of limited extent.

Jackson and Davidson (1975, p. 7) reported thin beds of iron carbonate in the lower part of the Arctic Bay Formation south of Maud Bight (map unit 9) but no other information on the nature or extent of this occurrence has been reported. The origin of iron formation boulders on Ragged Island and of hematite float at the snout of Sermilik Glacier near the south coast of Bylot Island is not known. Two high aeromagnetic anomalies near Oliver Sound (Jackson et al., 1975) probably reflect concentrations of iron. Thick hematite pods in Society Cliffs dolomite, occurring southeast of Nanisivik mine are considered to be oxidized remnants of large pyritic bodies. The oxide and silicate facies of iron formation reported south of Tay Sound are thin and relatively discontinuous. Their presence is significant from a regional metallogenic, rather than economic, point of view. Oxide facies iron formation has been reported to occur in unit 2 on the north shore of an unnamed lake approximately 6 km south of the head of Milne Inlet.

Gypsum

Beds of gypsum occur in shallowing upward evaporitic redbed sequences in the lower member of the Society Cliffs Formation east of Milne Inlet, but are common only on Bylot Island (unit 11; Map 1-1987). Gypsum is most abundant south of Tay Bay in Eclipse Trough where the lower 610 m of Society Cliffs strata contain at least 60 gypsum beds 10 cm to 3 m thick (Jackson et al., 1985, p. 644).

Coal

Four occurrences of coal in the study area have been reported by Caine (1973). Three of these, all of Tertiary age, are relatively small. The fourth, along the lower reaches of Salmon River (72°37'N; 78°05'W), is of Cretaceous age and occurs in at least six seams, one of which is about two metres thick. The coal has been determined to be sub-bituminous A in rank.

Coal also occurs 24 km southwest of Pond Inlet between Tunuiaqtalik and Eqeperiaqtalik points and just west of the terminus of Sermilik Glacier. According to unpublished reports of the Geological Survey of Canada and the Canada Centre for Mineral and Energy Technology (CANMET), the coal seams are not known to be continuous for much more

than 60 m. The coal has a high fusain content, is of sub-bituminous rank, is non-coking, and can be made into briquettes (Swartzman, 1947a, b). The coals are believed to have been mined for local consumption by native Inuit groups for hundreds of years.

Bitumen

Minute bitumen blebs are disseminated in trace amounts throughout much of the Society Cliffs Formation, the Athole Point Formation, and locally in the Victor Bay Formation. One Athole Point sample indicated traces of oil when examined with ultraviolet light (Jackson et al., 1975). Aquitaine Company of Canada Limited concluded from a suite of Eclipse Group samples that "Although abundant, the organic matter... shows little evidence of giving forth large quantities of liquid hydrocarbons because of its nature" (Appendix III in Jackson et al., 1975).

Adjacent to study area

The presence of a large iron deposit just outside the study area is of great significance because rock formations enclosing this deposit extend into the study area, thereby exerting a commanding influence on the perceived iron potential of the Bylot Island-Borden Peninsula region.

The larger of these two deposits, the Mary River iron deposit, is one of the world's richest concentrations of iron. Baffinland Iron Mines Ltd. has measured 127 000 000 tons of material grading 68% Fe in the No. 1 deposit, situated 75 km south of the southern edge of the map area (71°19'N; 79°14'W). The deposit consists of banded stratiform to massive, dense magnetite and hematite in iron-formation of the Mary River Group which extends into the Bylot Island-Borden Peninsula area where it is identified as Unit 2 in Figure 2. Much, if not most of the massive iron oxide in these deposits probably represent secondary enrichment that occurred at various times up to and including Cenozoic (Gross, 1966; Jackson, 1966; Jackson et al., 1978a).

METALLOGENIC SUMMARY

The relationship between mineral deposits (as entities) and their regional geological context is referred to as "metallogeny". Within the study area under consideration, 51 mineral occurrences have been identified and a major base metal deposit is currently under production. Just beyond the southern edge of the area, a high grade iron deposit is known to exist. These factors, combined with a good reconnaissance-level knowledge of most geological units, major structures, rock ages etc. permit certain metallogenic statements to be made as background to the mineral potential estimates which follow.

Metallogenic time-rock packages

Four major metallogenic time-rock packages exist within the study area. These are:

1. the Archean-Aphebian crystalline basement complex;
2. the Neohelikian Borden Rift Basin sedimentary rocks;
3. the early Paleozoic basin and shelf sedimentary rocks; and
4. the Cretaceous-Eocene fault-related sedimentary rocks.

Each of these packages, because of their age, lithology, and structure, possess their own metallogenic characteristics.

Archean-Aphebian Crystalline Basement Complex

Within this metallogenic package are contained Mary River Group volcanic rocks which host the large, high grade iron deposits south of the study area. Deposits of this type are considered to form as the result of hot spring emanations on the seafloor, the iron and silica having been leached from the volcanic rocks by heated seawater. In addition to iron and silica, base metals such as copper and zinc are leached from the same rocks and are expelled onto the seafloor to form metal sulphide deposits such as those in the Noranda and Flin Flon mining districts. In spite of their common genesis, however, Precambrian cherty iron formations and base metal sulphide deposits are seldom found closely associated and are, in fact, almost mutually exclusive. Thus, while a few occurrences of cherty, oxide facies iron formation have been reported in the study area, no occurrences of exhalative base metal sulphide have been noted. Small occurrences of iron formation are known only east of Milne Inlet and south of Oliver Sound; hence, all other areas of unit 2, outside this region, should be considered to have a low potential for massive sulphide deposits. Basement rocks also include the small ultramafic bodies similar to those elsewhere in the world which host nickel deposits. Pending more detailed mapping, however, the significance of these bodies with respect to potential nickel mineralization is uncertain.

Borden Rift Basin

This metallogenic package, consisting of as much as 6100 m of sedimentary rocks deposited in a tectonically active rift basin, is by far the most important metallogenic time-rock package of the study area. Extrusion of the Nauyat basalts during the initial rifting phase, the presence of evaporites in the shallower, eastern end of the basin (Society Cliffs and Elwin formations), and the transitions from a continental to a marine (Adams Sound to Arctic Bay formations; within Strathcona Sound Formation and within Elwin Formation) environment all constitute important metallogenic criteria for the possible occurrence of "Kupferscheifer" type copper deposits.

The thick Society Cliffs carbonate unit, overlain by Proterozoic and Phanerozoic sequences containing unconformities (Tables I and II), is an obvious metallogenic unit for Mississippi Valley type lead-zinc deposits. The fact that faulting was active during sedimentation in Borden Basin, as evidenced by, for example, the Fabricius Fiord Formation, provides an extremely important metallogenic factor for the occurrence of sedimentary-exhalative, stratiform, lead-zinc deposits. Formations indicative of slow sedimentation would be the best candidates to contain deposits of this type; examples would be the Arctic Bay Formation and the lower (VB_1) member of the Victor Bay Formation. Syndepositional faulting was also responsible for the shallow depositional environment present during deposition of most of the eastern Society Cliffs Formation, leading to the development of extensive gypsum beds in this part of the basin.

Paleozoic Basin and shelf sedimentary rocks

Up to 1000 m of early Paleozoic sedimentary rocks occur within the study area and, of these, units 19 (Ship Point Formation) and 20 (Baillarge Formation) are of metallogenic interest. Both formations consist of thick carbonate sequences overlain by disconformities. These disconformable contacts raise the possibility of dissolution (karstic) breccias of the type that host Mississippi Valley lead-zinc deposits. Indeed, a local solution zone has been recognized in upper Ship Point strata. Moreover, the lower Ship Point Formation (Member A) is a widespread sandstone unit. Thus, the upper Ship Point carbonates are "sandwiched" between an underlying sandstone (a potential aquifer for meteoric waters) and an overlying unconformity (evidence of subaerial exposure and, hence, potential ingress of meteoric waters). This situation is virtually identical to that of the Upper Mississippi Valley lead-zinc district of Wisconsin and Illinois (Heyl et al., 1959). The Early to early Middle Ordovician age of the Ship

Point Formation is very close to that of the host dolomites in the Upper Mississippi Valley district. The Late Middle Ordovician to Early Silurian age of the Baillarge Formation is close to that of dolomites hosting the currently-producing Polaris lead-zinc deposit on Little Cornwallis Island, 500 km northwest of the study area. Thus, several metallotects (geological features considered to be favourable indicators of mineralization) can be identified for the Ship Point and Baillarge formations.

Cretaceous-Eocene Sedimentary Rocks

About 3000 m of these rocks occur mainly in Eclipse Trough (Fig. 4) and consist almost entirely of continental clastic sedimentary rocks (Table III) whose metallogenic potential is thereby virtually nil.

Domains

The study area straddles the eastern end of a portion of the North Baffin Rift zone (Jackson and Iannelli, 1981). Extensive block-faulting occurred during Neohelikian time (i.e. mid-Proterozoic, between 1250 and 1000 m.y. ago), but has been active probably from the close of Aphebian to Recent time (e.g. seismic activity in eastern Lancaster Sound). The block-faulting, directed chiefly along northwesterly-trending faults, resulted in a series of alternating structural highs and lows (horsts and grabens) across the study area (Fig. 4). These fault blocks, and their contained rock types form the basis for outlining the five subdivisions in the study area referred to as domains (Map 1-1987).

Each of the domains is underlain predominantly by one of the four metallogenic time-rock packages. The structural highs (e.g. domains 2, 4, and 5), characterized by an abundance of basement rocks (units 1 to 6), received little or no sedimentation during Neohelikian time. The structural lows (e.g. domains 2 and 3) served as Neohelikian sedimentary basins (troughs) and contain up to 6100 m of sedimentary, and minor volcanic, rocks. The regional unconformity at the base of the Neohelikian strata dipped gently to the northwest. This permitted marine incursion into the basins from that direction. The northwest dip also produced the coalescence of structural lows in the northwest portion of the study area (e.g. Domain 3) in contrast to the structural highs which coalesced to the southeast (e.g. Domain 1). Lower Paleozoic marine sedimentary rocks (units 18 to 21) were deposited on an erosion surface that transected all older structures. Mesozoic and Cenozoic, marine, lacustrine, fluviatile, and glacial sediments (units 22 and 23) rest unconformably on basement gneisses and older sedimentary rocks of domains 1, 3, and 4 (Map 1-1987).

MINERAL AND HYDROCARBON POTENTIAL

Methods of assessment

The five domains described above were evaluated in the manner described below. It is important to emphasize that the study area was evaluated, domain by domain, for its potential to contain mineral deposits and hydrocarbon resources of the types described in the text, without consideration of the possible economic viability of any such predicted deposits. The objective of the study was to identify areas that, based on an evaluation of their presently known geological features, were judged to potentially contain as yet undiscovered deposits. For this reason, the present or future economic viability of any such deposits was not considered.

Minerals

Metallic and non-metallic mineral potential assessments are carried out on the basis of available measured data, specific geological information from known mineral deposits and occurrences, and on interpretation of the metallogeny of regional domains which involves the use of conceptual and genetic models. These have been discussed briefly by Sangster (1983; p. 72-73): "By this method the common and obvious geological parameters of many deposits of the same type are combined to erect a hypothetical or ideal descriptive and genetic model for each deposit type. Both regional and local geological features are an integral part of the conceptual model, but it is the former which are used most extensively in mineral resource evaluations. The conceptual models used are usually a combination of those published by other authors plus modifications based on G.S.C.'s mineral deposits geologists' extensive Canadian and world-wide examinations and studies of a variety of deposit-types (eg. Eckstrand, 1984). Drawing upon this experience, together with information from files of mineral deposits data compiled over many decades....., composite conceptual models are established and then compared with the geology of the area(s) being assessed.....(The) method probably differs little from the initial phase of many mineral exploration programs, most of which are also the result of intuitive deduction by experienced personnel". The geology of each domain being assessed is critically examined to determine which of the mineral deposit-types recognized by Geological Survey of Canada staff are likely to occur in that domain. Depending on the size and geological complexity, each domain may contain several deposit-types, as many as eight or nine in some domains.

Oil and Natural Gas

In estimating the size of undiscovered resources of petroleum in an area, the Geological Survey of Canada uses a probabilistic methodology conducted at the exploration-play level, combining objective data and informed geological opinion (Energy, Mines and Resources, 1977). Commonly referred to as the "Monte Carlo" approach the methodology has, in fact, advanced beyond this with the incorporation of more rigorous and powerful mathematical procedures (Roy, 1975; Roy et al., 1975). Estimates are displayed in probability terms, usually expressing a range of possible values rather than a single number. As exploration and production progress in a basin, the range of possible values is reduced (Procter et al., 1982).

In the present study, however, quantitative estimates were not required; therefore the domains shown in Figure 1 were simply rated for petroleum and natural gas, in a subjective manner, using the criteria in Table V.

Coal

Coal resource assessment is based on a consideration of all available exploration data, be they boreholes, trenches, surface exposures, adits or more generalized regional geological maps. Resources are subdivided by their distance from control points into several categories which reflect assurance of existence. Distance limits between these categories are controlled by the structural complexity of the deposit. In relatively undeformed deposits, measured, indicated and inferred assurance categories occur between 0 and 400 m, 400 and 800 m, and 800 and 2400 m, from a control point, respectively. Speculative resources, the category into which the present resource estimate falls, are those based only on a few scattered occurrences and the general configuration of coal-bearing strata. Resources are

Table V. Rating criteria used in hydrocarbon and mineral assessment

Rating scale	Rating	Criteria
1	Very High	Geological environment very favourable. Significant deposits present. Additional undiscovered deposits very likely.
2	High	Geological environment very favourable. Mineral or hydrocarbon occurrences present but no significant deposits known.
3	High-Moderate	
4	Moderate	Geological environment favourable. Mineral or hydrocarbon occurrences may not be present.
5	Low-Moderate	
6	Low	Aspects of the geological environment may be favourable, but limited in scope. Few, if and, mineral or hydrocarbon occurrences known. Undiscovered deposits unlikely.
7	Very low	Geological environment unfavourable. No mineral or hydrocarbon occurrences known. Undiscovered deposits very unlikely.

also subdivided by seam thickness and depth from surface into categories reflecting feasibility of exploration; and by rank and quality into categories reflecting probable end-use.

Assessment Rating Categories

After combining all pertinent factors (geological, geochemical, geophysical) in a subjective fashion, each domain is rated for its potential to contain undiscovered deposits of petroleum, natural gas, coal and minerals occurring as different deposit-types. The rating categories range from "very high" to "very low" depending on the number and kinds of favourable geological, geochemical and geophysical parameters present. Because the Bylot-northwest Baffin Island study area has received very little in the way of geochemical and geophysical coverage relative to geological coverage, the rating criteria are based almost entirely on geological factors (Table V).

Note that, according to these criteria, the presence of known mineral or hydrocarbon occurrences greatly enhances the assigned assessment rating. The presence of occurrences or deposits, representing the cumulative aspects of regional geological criteria, results in the rating categories being more logarithmic than arithmetic in nature. These cumulative effects are schematically illustrated by the curved line in Figure 6 which is intended to signify that the difference between categories 1 and 2 is much greater than that between 6 and 7.

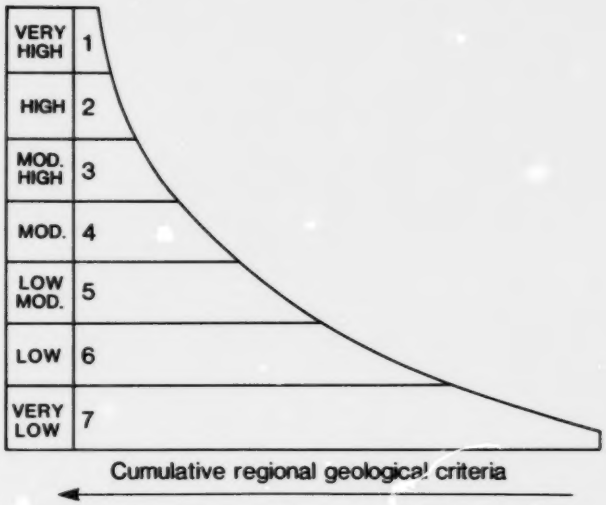


Figure 6. Diagram illustrating the relationships among potential-rating categories.

Results

Using the methods of assessment and the rating categories described above, the Bylot Island-northwest Baffin Island study area was assessed for its potential to contain petroleum, natural gas, coal, and five mineral deposit-types. The ratings assigned for each of these resources in the five domains is presented in Table VI.

Petroleum and Natural Gas

Domain 1 is composed of various Archean and Aphebian basement gneisses and without younger source rock cover there is virtually no chance for oil or gas to accumulate in this region.

Domain 2 contains an important succession of Mesozoic and Tertiary sediments. The Cretaceous-Tertiary Eclipse Group on southwestern Bylot Island is composed of 3000 m of terrestrially-derived sediment deposited in a graben of limited extent. The sediments in this location have a limited potential for generating gas and oil. The gas generating area is small and to date there are no indications of hydrocarbon accumulations in this area.

Domain 3 the sediments of Equalulik and Uluksan groups (units 7-10 and 11-12, respectively; Map 1-1987) might be considered more favourable if they were younger. Precambrian sediments, in general, are not known to generate hydrocarbons. The Society Cliffs Formation, however, has been reported to locally contain small particles of bituminous material and exhibits a fetid odour. Erosion and fracturing also limit the possibility of establishing a hydrocarbon trapping mechanism.

Domain 4 is composed of a mixed rock assemblage consisting of limited units of assemblages that appear in Domain 1 and Domain 3. The sparse, widespread distribution of Helikian and early Paleozoic sediments overlying basement gneisses precludes favourable conditions for accumulation and trapping of hydrocarbons.

Domain 5 is composed of lower Paleozoic Cambrian sediments of limited extent and thickness. No accumulations of hydrocarbons are indicated in this area.

Table VI. Undiscovered resources ratings, Bylot Island and northwest Baffin Island. Numbers refer to rating-potential

	Deposit-Type or Commodity								
DOMAIN	Petroleum	Gas	Coal	Stratiform Pb-Zn	Mississippi Valley-type Pb-Zn	Iron Formation	Ultramafic Ni	Gypsum	Sedimentary Cu
1	7	7	-	-	-	6	6	-	-
2	6	6	3	-	-	-	-	-	-
3	7	7	-	2	1	-	-	2	3,6
4	-	-	-	-	-	6	-	-	-
5	6	6	-	-	-	7	-	-	-

Attention should be drawn to the offshore of the study area which, although not included in the geological domains delineated in Figure 1, requires special note with regard to its petroleum and natural gas potential. In particular, the area immediately north of Bylot Island in Lancaster Sound and Baffin Bay contains up to 14 000 m of Mesozoic and Tertiary sediments deposited in a marine-deltaic environment within the Lancaster Sound Graben. The graben may also contain subcrops of lower Paleozoic and Helikian sediments. Although no hydrocarbon accumulations have been confirmed, industry has seismically delineated several prospects in the area with potential accumulations in the "giant" category. The area should therefore be included in a separate Domain composed of Phanerozoic sedimentary rocks and given a rating of 3 or 4 for oil and gas. If evidence of hydrocarbons are ultimately found to occur in the large closed structures that have been delineated, then a rating of 1 or 2 might be appropriate. For this reason it might be argued that the proposed park not extend into the offshore areas to the north and northwest of Bylot Island.

Coal

Only Domain 2 was rated for coal as all other domains are devoid of potential coal-bearing formations; it was assigned a rating of 3.

Iron

The only type of iron considered in this study is cherty iron formation (Gross, 1965, pp. 116-125) of Precambrian age, the largest type of commercial iron deposit in North America. Iron formation deposits consist mainly of large masses of interlayered silica (quartz) and iron oxide minerals such as magnetite or hematite. Archean iron formations are commonly found in association with volcanic rocks, greywacke, and slate. The Mary River deposits, situated south of the study area, represent extremely high grade examples of this deposit type. Early Proterozoic iron formations are commonly found in well-sorted detrital and chemical sedimentary sequences with a small volcanic component. Deposits near Schefferville, Labrador City, and Wabush, Quebec are examples of this type of cherty iron formation.

Only those domains which contain rocks of Archean age (i.e. domains 1, 4, and 5) were assessed for their potential to contain cherty iron formation deposits. Proterozoic sedimentary rocks of the other domains are not of the continental shelf type normally associated with cherty iron formations of this age.

Domains 1, 4, and 5 contain rocks of either map unit 2, which hosts the important Mary River deposits outside the study area as well as iron mineral locality no. 40 (Table IV), or map unit 3, in which up to 10% magnetite has been reported (Table IV, no. 28).

Large areas of map unit 3 are reported in Domain 1. Because the nature of the iron occurrence reported within it (no. 28) is not known in detail, it is unclear at this time whether favourable geology for this type of iron deposit exists elsewhere within map unit 3. Thus, according to the criteria listed in Table V, Domain 1 was assigned a rating of 6. Domain 4 contains a small occurrence of Archean cherty iron formation (no. 40) but the extent of the hosting unit (map unit 2) is limited. Therefore, Domain 4 also received a rating of 6. Domain 5 was rated 7 simply because of the Archean age of most rocks within it and the large tracts of map unit 3.

Sediment-hosted Stratiform Lead-Zinc

Frequently referred to as "shale-hosted", deposits of this type are stratiform bodies consisting of layers of massive galena, sphalerite, pyrite and/or pyrrhotite occurring in shaly sedimentary rocks. The adjective shaly is used for the host rocks to refer chiefly to good bedding fissility which is a common property. The dominant component of these rocks however, ranges from shale to silt, chert, fine-grained quartz, and dolomite. In view of this wide range in host rock lithologies, the sedimentary environments in which these deposits are found also exhibit a wide range. Indeed, they range from starved basins with little or no detrital sedimentation, to those continuously, or periodically, receiving detrital material in abundance, and from deep-water environments to those in which shallow water features are abundant.

The deposits themselves are regarded as being of exhalative origin, albeit in essentially nonvolcanic terranes. The metalliferous solutions are considered to have debouched from unknown sources, through fractures, onto the ocean floor. Most deposits can be shown to occur in topographic lows on the seafloor and, in some cases, metalliferous solutions appear to have migrated away from the exhalative centre before coming to rest in the depocentres where the sulphide mineral are eventually precipitated as the solutions cool.

The depocentres in any one region are commonly arranged in a linear pattern which, in some instances, can be shown to lie within a graben or half-graben. Thus both the depocentres and the exhalative vents may be genetically related by virtue of the mutual relationship to synsedimentary growth faults.

Where deposits of this type occur elsewhere in Canada and the world, they range up to 200 million tonnes in size. Average grades of currently-exploitable deposits range from 10% to 20% combined Pb-Zn content.

In a previous assessment of Borden Basin (Sangster, 1981), the Arctic Bay Formation (unit 9; Map 1-1987) was identified as being highly favourable for stratiform lead-zinc deposits. This perceived high potential was based on:

1. The abundant evidence of synsedimentary faulting during deposition of the Arctic Bay Formation sediments.
2. The series of horsts and grabens, identified as domains in Figure 1, produced small basins. These, in turn, suggest the possibility of smaller basins, the size of individual lead-zinc deposits, occurring in the area. The wide range in thickness of the Arctic Bay Formation, for example, might be an indication of these smaller basins.
3. The restricted deep-water depositional environment of Arctic Bay sediments. Slow sedimentation rates are ideal for the accumulation of sulphides; the lack of detrital material would allow even slow rates of exhalation of metalliferous brines to produce strata of significant metal content.
4. Presence of a high thermal gradient in the area, at least during deposition of the lower strata of the Bylot Supergroup, is suggested by the presence of alkalic basalts at the west end of the basin which were extruded in the early stages of rifting. The presence of contemporaneous volcanic activity is important for establishing higher-than-normal thermal gradients in the sedimentary basin. Anomalous thermal gradients would be capable of heating connate water in the trough sediments; the heated water could subsequently leach metals from the surrounding sediments, and then be driven up along synsedimentary faults to debouch onto the floor of the basin.
5. The presence of pyrite and siderite in the Arctic Bay Formation may be indicative of contemporaneous exhalative hydrothermal activity.

Some of these features also characterize members of the Victor Bay and Athole Point formations (map units 12 and 13) so these units must also be considered to have a high potential for stratiform lead-zinc deposits.

Domain III, in which the Arctic Bay, Victor Bay, and Athole Point formations (map units 9, 12, 13) occur in significant amounts, has therefore been assigned high ratings for deposits of this type.

Mississippi Valley-Type Lead-Zinc

Named after several well-known districts in the Mississippi Valley region of the United States, Mississippi Valley-type (MVT) deposits may be broadly described as low-temperature, epigenetic, open-space fillings in carbonate rocks. The deposits are not normally associated with igneous rocks and alteration of carbonate rock adjacent to the deposits is characteristically lacking. Sulphides of simple mineralogy (pyrite, sphalerite, galena), accompanied by dolomite, calcite and minor quartz, occur as cement to a carbonate breccia usually interpreted as karst-controlled solution collapse breccia.

Further details of the geological characteristics of MVT deposits may be found in Ohle (1959), Snyder (1968), and Anderson and Macqueen (1982). Although possessing some unusual and perhaps unique features, the Nanisivik deposit discussed earlier, displays many characteristics of MVT deposits and is generally regarded as being of this type.

Nanisivik, and many of the other Pb-Zn occurrences shown on Map 1-1987 and listed in Table IV, are found in map unit 12, the Society Cliffs Formation. This formation is widespread in Domain 3 and therefore imparts an especially high rating to this domain for MVT lead-zinc deposits.

Similarly, the unconformities reported above the Ship Point (map unit 19) and Baillarge (map unit 20) carbonates are important metallotects for Mississippi Valley type lead-zinc deposits in these formations. These units are widespread in the southernmost portion of Domain 3 (Map 1-1987).

Gypsum

Several gypsum beds of undetermined extent, are known in the Eskimo Inlet-White Bay (Milne Inlet Trough) and Maude Bight (North Bylot Trough) region of Domain III. The most extensive development of gypsum known occurs in Eclipse Trough south of Tay Bay (Jackson et al., 1985). All known gypsum occurrences are in the Society Cliffs Formation (map unit 12). The regional northwesterly dip which prevailed during trough sedimentation, together with syndepositional faulting, resulted in shallow water, evaporitic conditions east of Navy Board and Milne inlets in the southeasterly portion of Milne Inlet Trough, in North Bylot Trough, and in Eclipse Trough of western Bylot Island. These shallow water environments led directly to the accumulation of evaporite deposits, notably gypsum. Hence, map unit 12 in the easternmost portions of the three south-easterly-directed "prongs" of Domain 3 (Map 1-1987; Fig. 1; Fig. 2; Fig. 4) is considered to have the highest potential for undiscovered gypsum deposits.

Ultramafic-associated Nickel Sulphide

This type of nickel deposit most commonly occurs in Archean greenstone belts, and is associated with ultramafic flows and sills (Eckstrand, 1984). Within the greenstone belts, ultramafic flows and sills tend to occur at or near the base of volcanic cycles that comprise mafic flows and volcaniclastics in the lower to mid portion, and felsic units and siliceous sediments toward the top. The nickel sulphide deposits generally occur in the ultramafic units, commonly at their stratigraphically lower margins, and are considered to represent immiscible magmatic sulphide liquid segregations. In the case of ultramafic flows, the most significant nickel sulphide deposits tend to occur in the lowermost and most magnesian flow unit of the ultramafic pile. The size of orebodies generally ranges from less than one up to five million tonnes (Agnew in Western Australia contains more than 40 million tonnes) and grades average from 1 to 5% Ni, and 0.05 to 0.25% Cu.

Some reconnaissance level exploration for nickel deposits has been carried out on Baffin Island but no nickel occurrences have been reported. There would seem to be some potential for nickel, based on the presence of ultramafic rocks of Archean age in Domain I where ultramafic bodies occur in several areas. Two bodies are associated with supracrustal rocks on the headland 30 km southwest of Pond Inlet. Six other bodies form two clusters in migmatites along the south shore of Eclipse Sound near the southern margin of Navy Board High. Two or three small ultramafic bodies occur in migmatites along the promontory (Bruce Head) on the north side of Koluktoo Bay. A small layered intrusion occurs with supracrustal rocks west of central Navy Board Inlet and ranges in composition from gabbroic anorthosite to gabbro and ultramafic. Most of the ultramafic rocks identified are probably intrusions, are commonly associated with amphibolite (mafic metavolcanics?), mafic-rich metasediments, and in some cases with felsic metavolcanics. How they relate to the cyclicity of supracrustal rocks is not known. Because of the

predominant association with supracrustal rocks of an apparent greenstone belt, the nickel potential is given a 6 on the rating scale.

Sediment-hosted Stratabound Copper

Two types of sediment-hosted stratabound copper deposits have been recognized by Kirkham (1973) and other workers. The "Red Bed" type is small and hosted by continental sandstone rocks. The "Kupferschiefer" type is laterally extensive and hosted by strata which were deposited at transitions between continental redbed conditions and marine or saline lacustrine conditions. The "Kupferschiefer" type is of greater economic interest, being represented by deposits such as the Kupferschiefer and Flowerpot Shale of Permian age in Poland and U.S.A., respectively, and the Zambian, White Pine (U.S.A.) and Redstone (Canada) deposits of Late Proterozoic age. Both types are regarded as diagenetic in origin, copper having been leached from redbeds or weathered hinterlands and added to favourable, chemically-reduced horizons. In the "Kupferschiefer" type deposits, grades generally range from 1 to 4% Cu; thicknesses from less than 10 cm to greater than 100 m, and lateral extents from several to hundreds of kilometres.

Several features that are present in some or all of these deposit types have been described by Jackson and Iannelli (1981 and above) for the Bylot and northwest Baffin Island area:

1. An upward transition from subaerial redbeds to marine sandstones and dolostones has been recognized in the Elwin Formation. Redbeds and algal dolostones are intercalated in the lower Society Cliffs Formation. Marked facies changes characterize the Strathcona Sound Formation. Involved are thick red clastic wedges north and south of Navy Board High, intertonguing and thick overlying green clastics, and biohermal complexes developed proximally to a growth fault. These elements are reminiscent of the setting of the Troy Ag-Cu deposit in Montana (Hayes and Balla, 1986).
2. Minor, local copper showings have been found. Jackson et al. (1975) noted that, "A semiquantitative spectrographic analysis of red gypsiferous shale from the Society Cliffs Formation west of Tay Sound yielded 0.15% copper".
3. Gypsum beds, desert roses, and gypsum and halite casts occur in the lower member of the Society Cliffs Formation. Halite casts are abundant, locally, in the lower member of the Elwin Formation.
4. Basalts of the Nauyat Formation occur below and in geographic proximity to the favourable stratigraphic beds of the lower Society Cliffs and Elwin formations. Basalts have been regarded as a logical source of copper which was later concentrated into sedimentary deposits. The significance of the Nauyat basalts may be somewhat reduced, however, because they appear to have been erupted during clastic sedimentation, were rapidly buried with negligible weathering, and are absent in at least two of the three areas which contain the most favourable Society Cliffs redbeds. The Nauyat basalts contain traces of native copper, and traces of copper sulphides occur in the basalts and in adjacent quartzarenites. Therefore the Nauyat basalts may contain small native copper deposits (eg. Scoates et al., 1986).
5. Active tectonism represented by rapid lateral facies changes and synsedimentary faults is regarded by some workers as genetically important. These criteria were noted by Jackson and Iannalli (1981) throughout much of Borden Basin sedimentary succession.

Two features of possible genetic significance suggest that "Kupferschifer" occurrences, if present, may be of limited extent in the Society Cliffs and Elwin Formations. The first is the limited thickness of continental red clastic rocks below the reduced zone. Redbeds of the Society Cliffs and Strathcona Sound formations are intercalated with reduced clastic and carbonate beds of marine origin. The redbeds would have had limited capacity for storage and release of cupriferous groundwaters involved in formation of diagenetic copper deposits.

The second limitation is the configuration of the depositional basin. Recent studies on the Redstone (Kirkham, personal communication, Ruelle, 1982; Jefferson, 1983) and Zambian (Clemmey, 1978) Copperbelts suggest that copper may have been concentrated by evaporation in basins with internal drainage patterns. The Borden Rift Basin appears to have been dominated by tidal marine sedimentation, although lacustrine sedimentation may have been important in the more continental parts of the rift grabens.

Based on the above features (eg. thick redbeds, growth faults, reef complexes), a rating of 3 is assigned the Strathcona Sound Formation in Domain 3 on central Borden Peninsula north and south of western Navy Board High (Fig. 1, Table VI). An overall rating of 6 is assigned to the remainder of Domain 3. The southeast portions of this remainder, however (Milne Inlet-Tay Sound, Navy Board Inlet, and Maud Bight areas), contain continental rocks associated with good examples of redbeds and evaporites, and minor copper showings (eg. Society Cliffs Formation). Therefore, of the remainder, the southeast portions have the greater potential for undiscovered stratabound copper deposits.

Carving stone

Stone (serpentinite, argillite, marble, etc.) suitable for making carvings and stone prints, occurs at various places on Baffin Island (eg. Gibbins, 1982) and is probably present at several localities within the study area. Bylot Supergroup strata that have undergone contact metamorphism adjacent to Hadrynian Franklin diabases (Fig. 5) is being quarried west of Arctic Bay. A large number of these diabase dykes intrude the Bylot Supergroup so there should be several more similar occurrences in the region.

Serpentinite is currently being quarried at Mary River, just south of the study area. Walter Gibbins (personal communication) has noted that carving productivity roughly doubled at Pond Inlet when the Mary River stone came into use. Small sporadic occurrences of ultramafic rocks occur, with other Mary River Group rocks, in the basement gneisses throughout the study area. Although most of the known occurrences may be too highly metamorphosed to be of use, some probably contain usable stone.

The suitability of stone for carving is so subjective, and the economics concerned so variable that no attempt is made here to identify and classify present deposits or to determine the likelihood of finding additional deposits.

ACKNOWLEDGMENTS

We are most grateful to several individuals who have contributed substantially to this report. Borden Rift Basin has been discussed at length with T.R. Iannelli, while various aspects of the Basin have been discussed with A. Galley, G. Narbonne, and R.D. Knight. Mineral and hydrocarbon potentials were discussed with and assessments provided by G.A. Gross (iron), O.R. Eckstrand (nickel), C.W. Jefferson (copper), and the Institute of Sedimentary and Petroleum Geology (petroleum and natural gas). M. McComb (Parks Canada) provided text material pertaining to selection of National Park areas.

R.D. Lancaster compiled the map components onto a common base and gathered data for Table IV. The map and Figure 1 were drafted by G. Young, and R. Bretzlaff compiled Table IV. K. Bencik drafted Figures 2-5. We wish to especially thank R.F.J. Scoates and G.M. Yeo for excellent critical review of the manuscript. Any errors are, of course, our own responsibility.

REFERENCES

Agar, F. and Farquharson, G.
1980: The world's most northerly metal mine; in Risk taking in Canadian Mining, p. 133-141, J. Carrington, Chief Technical Editor, G. Lonn, L.C. Brown and P. Tremblay Associates; Pitt Publishing Co. Ltd., Toronto, Ontario, Canada.

Anderson, G.M. and Macqueen, R.W.
1982: Ore deposit models. 6. Mississippi Valley-type lead-zinc deposits; Geoscience Canada, v. 9, p. 108-117.

Blackadar, R.G.
1970: Precambrian geology northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 91, 89 p.

Blackadar, R.G., Davison, W.L., and Trettin, H.P.
1968a: Milne Inlet, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1235A.

1968b: Navy Board Inlet, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1236A.

1968c: Arctic Bay-Cape Clarence, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1237A.

1968d: Moffet Inlet-Fitzgerald Bay, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1238A.

1968e: Berlinguet Inlet-Bourassa Bay, District of Franklin (map with marginal notes); Geological Survey of Canada, Map 1241A.

Caine, T.W.
1973: Coal in the Arctic Archipelago; Canada, Department of Indian Affairs and Northern Development, Exploration and Geological Services Unit, 24 p.

Christie, K.W. and Fahrig, W.F.
1983: Paleomagnetism of the Borden dykes of Baffin Island and its bearing on the Grenville Loop; Canadian Journal of Earth Sciences, v. 20, p. 275-289.

Christie, R.L., Cook, D.G., Nassichuk, W.W., Trettin, H.P., and Yorath, C.J.
1972: The Canadian Arctic Islands and the Mackenzie region; 24th International Geological Congress, Guidebook Excursion A-66, 146 p.

Clayton, R.H. and Thorpe, L.
1982: Geology of the Nanisivik zinc-lead deposit; in Precambrian sulphide deposits, H.S. Robinson Memorial Volume; R.W. Hutchinson, C.D. Spence and J.M. Franklin, editors; Geological Association of Canada, Special Paper 25, p. 738-758.

Clemmey, H.
1978: A Proterozoic lacustrine interlude from the Zambian Copperbelt; in Modern and Ancient Lake Sediments, A. Matter and M.E. Tucker (editors), International Association of Sedimentologists, Special Publication No. 2, Blackwill Scientific Publication, London, p. 259-278.

Craig, B.G.
1965: Notes on moraines and radiocarbon dates in northwest Baffin Island, Melville Peninsula, and northeast District of Keewatin; Geological Survey of Canada, Paper 65-20, 7 p.

Eckstrand, O.R.
1984: Canadian mineral deposit types: A geological synopsis; Geological Survey of Canada, Economic Geology Report 36, 86 p.

Energy, Mines and Resources
1977: Oil and natural gas resources of Canada 1976; Energy, Mines and Resources Canada, Report EP 77-1, 76 p.

Fahrig, W.F. and Schwarz, E.J.
1973: Additional paleomagnetic data on the Baffin diabase dikes and a revised Franklin pole; Canadian Journal of Earth Sciences, v. 10, no. 4, p. 576-581.

Fahrig, W.F., Christie, K.W., and Jones, D.L.
1981: Paleomagnetism of the Bylot Basins: Evidence for Mackenzie continental tensional tectonics; in Proterozoic Basins of Canada, F.H.A. Campbell, ed., Geological Survey of Canada, Paper 81-10, report 17.

Fahrig, W.F., Irving, E., and Jackson, G.D.
1971: Paleomagnetism of the Franklin Diabases; Canadian Journal of Earth Sciences, v. 8, no. 4, p. 455-467.

Falconer, G.
1962: Glaciers of northern Baffin and Bylot Islands, N.W.T.; Canada, Geographical Branch, Geographical Paper No. 33, 31 p.

Fraser, J.A., Heywood, W.W., and Mazurski, M.A.
1978: Metamorphic map of the Canadian Shield; Geological Survey of Canada, Map 1475A, scale: 1:3 500 000.

Frisch, T.
1983: Reconnaissance geology of the Precambrian Shield of Ellesmere, Devon and Coburg Islands, Arctic Archipelago: a preliminary account; Geological Survey of Canada, Paper 82-10, 11 p.

Galley, A.
1978: The petrology and chemistry of the Nauyat Formation volcanics, Borden Peninsula, Northwestern Baffin Island; unpublished B.Sc. Thesis, Carleton University, 53 p.

Galley, A.G., Jackson, G.D., and Iannelli, T.R.
1983: Neohelikian subaerial basalts with ocean floor-type chemistry, northwestern Baffin Island; Geological Association of Canada, Program with Abstracts, v. 8, abstract, p. A25.

Geldsetzer, H.
1973a: Syngenetic dolomitization and sulfide mineralization; in Ores in Sediments, G.G. Amstutz and A.J. Bernard, ed., Springer-Verlag, p. 115-127.

1973b: The tectono-sedimentary development of an algal-dominated Helikian succession on northern Baffin Island, N.W.T.; in Symposium on Arctic Geology, Geological Association of Canada, Memoir 19, J.D. Aitken and D.J. Glass, ed., p. 99-126.

Gibbins, W.A.
1979: Hawker Creek Project – TR Claims; Canada, Department of Indian and Northern Affairs, Mineral Industry Report 1977, EGS 1979-1, p. 26.

Gibbins, W.A. (cont.)
1982: DIAND-GNWT-COOP-Soapstone project Baffin Island 1981; Canada, Department of Indian Affairs and Northern Development; Geology Section, internal report, 7 p.

Graf, C.W.
1974: A trace metal analysis across the Arctic Bay-Society Cliffs Formations contact, Borden Peninsula, Baffin Island, Northwest Territories; unpublished B.Sc. Thesis, University of British Columbia, 63 p.

Gross, G.A.
1965: Geology of iron deposits in Canada, Vol. I. General geology and evaluation of iron deposits; Geological Survey of Canada, Economic Geology Report No. 22, 181 p.

1966: The origin of high grade iron deposits on Baffin Island, Northwest Territories; Canadian Mining Journal, v. 87, p. 111-114.

Hayes, T.S., and Balla, J.C.
1986: Troy Mine; in Proterozoic sediment-hosted stratiform copper deposits of upper Michigan and Belt Supergroup of Idaho and Montana, A.C. Brown and R.V. Kirkham ed.; Geological Association of Canada, Mineralogical Association of Canada, Canadian Geophysical Union, joint annual meeting, Ottawa 1986, Field Trip 1; Guidebook, pp. 54-64.

Heyl, A.V., Agnew, A.F., Lyons, E.J., and Behre, C.H.
1959: The geology of the Upper Mississippi Valley lead-zinc district; United States Geological Survey, Professional Paper 309, 310 p.

Hodgson, D.A. and Haselton, G.M.
1974: Reconnaissance glacial geology, northeastern Baffin Island; Geological Survey of Canada, Paper 74-20, 10 p.

Iannelli, T.R.
1979: Stratigraphy and depositional history of some upper Proterozoic sedimentary rocks on northwestern Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 79-1A, p. 45-56.

Jackson, G.D.
1966: Geology and mineral possibilities of the Mary River region, northern Baffin Island; Canadian Mining Journal, v. 87, no. 6, p. 57-61.

1978: Basement gneisses and the Mary River Group, No. 4 Deposit area, northwest Baffin Island, District of Franklin; in Wanless, R.K. and Loveridge, W.D., 1977, Rubidium-Strontium Isotopic Age Studies, Report 2; Geological Survey of Canada, Paper 77-14, p. 18-24.

Jackson, G.D. and Cumming, L.M.
1981: Evaporites and folding in the Neohelikian Society Cliffs Formation, northeastern Bylot Island, Arctic Canada; in Current Research, Part C, Geological Survey of Canada, Paper 81-1C, p. 35-44.

Jackson, G.D. and Davidson, A.
1975: Bylot Island map-area, District of Franklin; Geological Survey of Canada, Paper 74-29, 12 p.

Jackson, G.D., Davidson, A., and Morgan, W.C.
1975: Geology of the Pond Inlet map-area, Baffin Island, District of Franklin; Geological Survey of Canada, Paper 74-25, 33 p.

Jackson, G.D. and Iannelli, T.R.
1981: Rift-related cyclic sedimentation in the Neohelikian Borden Basin, northern Baffin Island; in Proterozoic basins of Canada, F.H.A. Campbell, editor; Geological Survey of Canada, Paper 81-10, p. 269-302.

– Neohelikian reef complexes, Borden Rift Basin, northwestern Baffin Island; in Canadian Society of Petroleum Geology memoir – "Reef Case Histories", H.H. Geldsetzer and N.P. James editors. (in press)

Jackson, G.D., Iannelli, T.R., Narbonne, G.M., and Wallace, P.J.
1978a: Upper Proterozoic sedimentary and volcanic rocks of northwestern Baffin Island; Geological Survey of Canada, Paper 78-14, 15 p.

Jackson, G.D., Iannelli, T.R., and Tilley, B.J.
1980: Rift-related late Proterozoic sedimentation and volcanism on northern Baffin and Bylot Islands, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 80-1A, p. 319-328.

Jackson, G.D., Iannelli, T.R., Knight, R.D., and Lebel, D.
1985: Neohelikian Bylot Supergroup of Borden Rift Basin, northwestern Baffin Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 85-1A, p. 639-649.

Jackson, G.D. and Morgan, W.C.
1978: Precambrian metamorphism on Baffin and Bylot Islands; in Metamorphism in the Canadian Shield, J.A. Fraser and W.W. Heywood, ed., Geological Survey of Canada, Paper 78-10, p. 249-267.

Jackson, G.D., Morgan, W.C., and Davidson, A.
1978b: Geology Icebound Lake, District of Franklin; Geological Survey of Canada, Map 1451A, coloured, 1:250 000.

Jefferson, C.W.
1983: The Upper Proterozoic Redstone Copper Belt, Mackenzie Mountains, Northwest Territories: unpublished Ph.D. thesis, University of Western Ontario, London, Ontario, 445 p.

Kerr, J.W.
1977: Cornwallis lead-zinc district; Mississippi Valley-type deposits controlled by stratigraphy and tectonics; Canadian Journal of Earth Sciences, v. 14, p. 1402-1426.

1980: Structural framework of Lancaster Aulacogen, Arctic Canada; Geological Survey of Canada, Bulletin 319, 24 p.

Kirkham, R.V.
1973: Environments of formation of concordant and peneconcordant copper deposits in sedimentary sequences (abstract) Canadian Mineralogist, v. 12, part 2, p. 145-146.

Klassen, R.A.
1981: Aspects of the glacial history of Bylot Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 81-1A, p. 317-326.

1982: Glaciotectonic thrust plates, Bylot Island, District of Franklin; in Current Research, Part A, Geological Survey of Canada, Paper 82-1A, p. 369-373.

Lemon, R.R.H. and Blackadar, R.B.
1963: Admiralty Inlet area, Baffin Island, District of Franklin; Geological Survey of Canada, Memoir 328, 84 p.

Miall, A.D., Balkwill, H.R., and Hopkins, W.S., Jr.
1980: Cretaceous and Tertiary sediments of Eclipse Trough, Bylot Island area, Arctic Canada, and their regional setting, Geological Survey of Canada, Paper 79-23, 20 p..

Ohle, E.L.
1959: Some considerations in determining the origin of ore deposits of the Mississippi Valley type; Economic Geology, v. 54, p. 769-789.

Olson, R.A.
1977: Geology and genesis of zinc-lead deposits within a late Precambrian dolomite, northern Baffin Island, N.W.T.; unpublished Ph.D. Thesis, University of British Columbia, 371 p.

1984: Genesis of paleokarst and strata-bound zinc-lead sulfide deposits in a Proterozoic dolostone, northern Baffin Island, Canada; Economic Geology, v. 79, p. 1059-1103.

Pawlowski, I.R.
1976: An investigation of coal exposures near Pond Inlet, Baffin Island; Department of Indian and Northern Affairs, Mineral Industry Report 1976, Northwest Territories, EGS 1978-11, p. 136-138.

Procter, R.M., Lee, P.J., and Taylor, G.C.
1982: Methodology of petroleum resource evaluation; Paper presented to the Petroleum Resource Assessment Workshop and Symposium; Third Circum Pacific Energy and Mineral Resources Conference, Honolulu, 1982.

Roy, K.J.
1975: Hydrocarbon assessment using subjective probability and Monte Carlo methods; First International Institute for Applied Systems Analysis conference on methods and models for assessing energy resources; Pergamon Press, p. 279-290.

Roy, K.J., Procter, R.M., and McCrossan, R.G.
1975: Hydrocarbon assessment using subjective probability; in Probability methods in oil exploration; American Association of Petroleum Geologists Research Symposium.

Ruelle, J.C.
1982: Depositional environments and genesis of stratiform copper deposits of the Redstone Copper Belt, Mackenzie Mountains, Northwest Territories; in Precambrian Sulphide Deposits, H.S. Robinson Memorial Volume; R.W. Hutchinson, C.P. Spence and J.M. Franklin, editors, Geological Association of Canada, Special Paper 25, p. 701-737.

Sangster, D.F.
1981: Three potential sites for the occurrence of stratiform shale-hosted lead-zinc deposits in the Canadian Arctic; in Current Research, Part A, Geological Survey of Canada, Paper 81-1A, p. 1-8.

Scoates, R.F.J., Jefferson, C.W., and Findlay, D.C.
1986: Northern Canada mineral resource assessment; in Prospects for mineral resource assessments on public lands: proceedings of the Leesburg Workshop, edited by S.M. Cargill and S.B. Green; U.S. Ceological Survey Circular 980, p. 121.

Sinha, A.K. and Frisch, T.
1975: Whole-rock Rb/Sr ages of metamorphic rocks from northern Ellesmere Island, Canadian Arctic Archipelago. I. The gneiss terrain between Ayles Fiord and Yelverton Inlet; Canadian Journal of Earth Sciences, 12, p. 90-94.

1976: Whole-rock Rb/Sr and zircon U/Pb ages of metamorphic rocks from northern Ellesmere Island, Canadian Arctic Archipelago. II. The Cape Columbia Complex; Canadian Journal of Earth Sciences, v. 13, p. 774-780.

Snyder, F.G.
1968: Geology and mineral deposits, midcontinent United States, p. 257-286; in Ore deposits of the United States, v. 1 (J.D. Ridge, ed.), American Institute of Mining, Metallurgical and Petroleum Engineers, Inc.

Stockwell, C.H.
1982: Proposals for time classification and correlation of Precambrian rocks and events in Canada and adjacent areas of the Canadian Shield, Part 1: A time classification of Precambrian rocks and events; Geological Survey of Canada, Paper 80-19, 135 p.

Swartzman, E.
1947a: Report on a study of the physical and chemical characteristics of coal occurring at Pond Inlet, Baffin Island, Northwest Territories; Fuel Research Laboratories, Bureau of Mines, Canada, Department of Mines and Technical Surveys, F.R.L. No. 58, 26 p., unpublished report.

1947b: Concluding Report on the briquetting amenability of coal from Pond Inlet, Salmon River, Baffin Island conducted for the administration of the Northwest Territories; Fuel Research Laboratories Bureau of Mines, Canada, Department of Mines and Technical Services, F.R.L. No. 64, 18 p., unpublished report.

Trettin, H.P.
1969: Lower Paleozoic sediments of northwestern Baffin Island, District of Franklin; Geological Survey of Canada, Bulletin 157, 70 p.

1975: Investigations of Lower Paleozoic geology, Foxe Basin, northeastern Melville Peninsula and parts of northwestern and central Baffin Island; Geological Survey of Canada, Bulletin 251, 177 p.

1983: Franklinian mobile belt of the Arctic: Early Paleozoic link between Caledonian and Cordilleran belts; Geological Association of Canada, Program with Abstracts, v. 8, abstract, p. A69.

Trettin, H.P. and Balkwill, H.R.
1979: Contributions to the tectonic history of the Innuitian Province, Arctic Canada; Canadian Journal of Earth Sciences, v. 16, no. 3, p. 748-769.

Trettin, H.P., Frisch, T., Sobczak, L.W., Weber, J.R., Niblett, E.R., Law, L.K., de Laurier, I., and Whitham, K.
1972: The Innuitian Province; in Variations in Tectonic Styles in Canada, R.A. Price and R.J.W. Douglas, eds., Geological Association of Canada, Special Paper no. 11, p. 83-181.

Wanless, R.K.
1970: Isotopic age map of Canada; Geological Survey of Canada, Map 1256A, scale: 1:5 000 000.

Energy, Mines and Resources Canada
Énergie, Mines et Ressources Canada